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THE MEDICAL REPORT OF THE RICE EXPEDITION TO BRAZIL

BY

W. T. COUNCILMAN, M.D.

AND

R. A. LAMBERT, M.D.

FROM THE SCHOOL OF TROPICAL MEDICINE
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TO

MRS. A. HAMILTON RICE

AS AN APPRECIATION OF HER ENDURANCE,
PATIENCE, FORTITUDE, AND CHEERFULNESS
THIS WORK IS RESPECTFULLY DEDICATED
BY THE AUTHORS

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INTRODUCTION

THE expedition, primarily undertaken for geographical research, was organized by Doctor A. Hamilton Rice, and left New York on the steam yacht *Alberta*, November 16, 1916. The members of the expedition were Doctor and Mrs. A. H. Rice, Mr. Howe, geologist, Mr. Swanson, wireless operator, Mr. Cousens, engineer, Mr. Church, cartographer, and the writers. Stops were made on the way to and from Brazil at Barbados and at Porto Rico. From Barbados we proceeded on the yacht to Pará, to Manaos, and to Iquitos in Peru, returning from there to Manaos. At Manaos a river steamer was taken to San Isabel on the Rio Negro, and from there we proceeded to San Gabriel on a launch which was constructed in New York for this purpose, and sent to Manaos on a commercial steamer.

The main purpose of the expedition was the study of the physical geography of the Casiquiare Canal (a natural waterway between the Rio Negro and the Orinoco River), the branches of this, and the region. This particular region has enjoyed an unenviable reputation from the great numbers, the variety, and the rapacity of the insects, and from the severe character of the endemic diseases. It is also a region which is rarely visited save by the rubber traders and about which little is known. Owing to the unprecedented low water in the Rio Negro it was not possible to go further up than to San Gabriel, where we waited for three weeks in daily expectation of a rise in the river. The river,

however, continued to fall, and reports from higher up were that the canal was not passable even for a large canoe. From San Gabriel the return to Manaos was made on the launch, one of the party only (W. T. C.) coming down the river from San Isabel on a steamer. In the ascent of the Rio Negro the south bank, the usual route, was followed, and the descent to Manaos, which was made in the launch, was to a considerable extent along the north bank, which is little known. Both going and coming stops were made at the small towns and villages, and at many of the rubber estates, and the inhabitants were examined. The prolonged stay at San Gabriel gave a good opportunity for the study of the conditions of the region. From Manaos one of the party (W. T. C.) made a trip on a river steamer through the series of rivers, lakes, and streams on the south of the Amazon between Manaos and the Madeira river. In passing up the Amazon to Iquitos a number of stops were made at the small towns along its banks. In Pará, Manaos, and Iquitos the hospitals were visited and the cases in the wards were studied. All of the physicians encountered were most kind, and all medical facilities were freely placed at our disposal. This was in accord with the hospitality shown us everywhere.

MEDICAL REPORT OF THE RICE EXPEDITION TO BRAZIL

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The Amazon Valley

It is necessary before a consideration of the diseases of this region to give some account of its physical characteristics, for the two are closely interlinked. The land of the Amazons, including the great valley and the lower watershed, is in several respects the most remarkable and interesting region on earth. It is the largest area on earth which can be treated as a unit and in which practically the same conditions prevail. There are various estimates of its extent, ranging from 1,500,000 to 2,722,000 square miles, the difference depending upon what are regarded as the limits of the region. The region extends in the west to the Andes, to the high table-lands of the Matto Grosso in the south, to the high lands and the coastal range of mountains on the east, broken only by a few hundred miles at the mouth of the river, and to the mountains of Venezuela and Guiana on the north. The valley itself is almost as flat as the sea. There has been much difficulty in ascertaining altitude owing to the influence of atmospheric conditions on the barometer. The very careful estimates of Rice made on this expedition give 83 feet at Manaos, and 315 feet at Iquitos, 151 at San Isabel and 225 at San Gabriel. The trade winds sweep across the valley from east to west carrying, in great purple and white cumulus clouds, masses of water vapor, which partly is precipitated over the valley in passing, but the height of

discharge is reached on the slopes of the Andes, where the clouds meet the cold air of the mountains.[1] A glance at a map shows great numbers of rivers coming from the north and south, which flow into the Amazon, and these become more numerous in the west as the Andes are approached. The volume of water discharged is

[1] "The northeast trade winds commence to blow about the Tropic of Cancer, and coming from the quarter they do, they blow obliquely across the Atlantic. They evaporate from the sea as they go; and, impinging at right angles upon the South American shore-line that extends from Cape St. Roque to Cabo La Vela, they carry into the interior the vapor that forms the clouds that give the rain which supplies with water the Magdalena, the Orinoco, and the northern tributaries of the Amazon.

The volume of water discharged by these rivers into the sea is expressive of the quantity which those northeast trade winds take up from the sea, carry in the clouds, and precipitate upon the water-shed that is drained by these streams. They are but pipes and gutters which Nature has placed under the eaves of the great water-shed that has the Andes for a ridge-pole, the Caribbean sea and North Atlantic for a cistern.

The trade-wind region of the North Atlantic affords the water-surface where the evaporation is carried on that supplies with rains, dews, and moisture, New Granada, Venezuela, the three Guianas, and the Atlantic slopes of Ecuador.

On the other hand, the southeast trade winds commence to blow about the parallel of 30° or 35° south. They, too, come obliquely across the Atlantic, and strike perpendicularly upon the South American coast-line which extends from Cape St. Roque towards Cape Horn. They pass into the interior with their whole load of moisture, every drop of which is wrung from them before they cross the Andes. The quantity of moisture which is taken up from the sea and rained down upon this wonderfully fruitful country may be seen in what the La Plata and the Amazon discharge back into the ocean.

Now, there is no tropical country in the world which has to windward, and so exactly to windward of it, such an extent of ocean in the trade-wind region. Consequently there is no inter-tropical country in the world that is so finely watered as is this great Amazon country of South America.

Along the Atlantic coast of the United States, along the coast of China, and the east coast of New Holland, the land trends along with the direction of the trade winds of those regions. These winds, with their moisture, travel along parallel with the land. They do not blow perpendicularly upon it, nor push their vapors right across it into the interior, as they do in South America. The consequence is, none of those inter-tropical countries can boast of streams and water-courses like those of South America."— "The Amazon," and "The Atlantic Slopes of South America," by M. F. MAURY, LL.D., Lieutenant U. S. Navy.

enormous. Leaving out of consideration that of the Pará estuary which receives the Tocantins and several smaller rivers, the discharge of the Amazon proper is greater than that of the Mississippi and Nile combined, the great flood converting the ocean into a fresh water sea for one hundred and fifty miles from the coast. This statement is based on estimates made of the outflow at Obidos, where the river bed is constricted between high *terra firme* to a width variously estimated at one and one and a half miles. Wallace made his estimate of the discharge, 750,000 cubic feet per second, by taking an average depth of fifty feet, a width of one mile, and a current of four miles an hour. Herndon, however, has made soundings here, showing depths of one hundred and fifty, one hundred and seventy, two hundred and ten and two hundred and forty feet, and the great rivers, Tapajos and Xingu, enter the Amazon stream below Obidos. Wallace has also estimated the rainfall of the valley and finds that the estimated rainfall 1,500,000 feet per second corresponds with the estimated discharge estimating the evaporation at one-half the rainfall.[1]

The color of the Amazon is a pale cloudy yellow; the color is due to a finely divided silt which precipitates slowly and imperfectly. Many of the tributary streams have the same character, while others are clear and of various shades of amber, and these are known as the black water rivers, the best type being the Rio Negro.[2]

The height of the land along the river varies, being much lower in certain places, and has received in relation

[1] Estimates play a predominating part in all descriptions of the physical features of South America.

[2] "Soon afterwards we discovered a river, on the left hand, with water as black as ink, the force of which was so great that for more than twenty leagues its waters flowed separately, without mingling with the Amazons river." — ORELLANA, 1539.

to its height above water certain designating names. The entire low region subject to flood is known as the flood plain, and this is divided into *igapó* and *varzea*. The *igapó*, really a swamp forest, (Fig. 1) is the lowest land, but a few feet above the mean level, and is subject to overflow by the tides in the east and by slight rises in the river. The principal area of the igapó is the flat

FIG. 1. IGAPÓ ON LOWER AMAZON.

coastal region east of Obidos. It is a country of islands separated by sluggish but often deep channels, of rivers and of lakes, the whole unstable and constantly changing. The *varzea* is the higher land which is overflowed only during the high floods. The *terra firme* is still higher land, which is not subject to overflow. All of the rivers in the valley have igapó and varzea on both sides of them and extending a varying distance, broken here and there by higher terra firme. The terra firme represents more than a difference in altitude, for it has a clay or rock foundation, a sand surface and is stable.

The igapó and varzea are formed of alluvium; the land constantly changing, disappearing in one place, forming in another; large islands disappear in the floods, others are formed, igapó becomes varzea and vice versa (Figs. 2 and 3). While on the way to Iquitos we saw a large section of the bank covered with high forest fall into the river and completely disappear. The best conception of the condition is gained by regarding the entire flood plain as a great lake which has been filled with sediment until only the rivers remain.

The region is covered with forest, in extent the largest forest in the world; the towns and the clearings in it represent merely pin pricks. On the outskirts of the valley there are great regions, known as campas, free from forest, resembling the American prairies and capable of pasturing immense herds of cattle. Wallace states that from Tabatinga on the border of Peru a circle can be drawn with a radius of eleven hundred miles, all of which will be within the forest. Outside of this, smaller circles with radii up to four hundred miles can still be included. The varieties of trees and the density of the forest vary somewhat in different regions, but the general characteristics are the same. The trees are tall and closely placed; the trunks generally smooth and pale in color, giving off no branches until the forest roof, eighty to a hundred feet above the ground, is reached. Above this roof the domes of many of the higher trees project. Between the tall trees there is another forest of slender, shade-loving trees, and of others which await an opening in the roof through which to get their heads into the light. Vines are everywhere, trailing over the ground, extending up the trunks of trees and as long tightly stretched ropes descending from the trees to the earth. Most of the latter are the aerial roots of

FIG. 2. VARZEA FOREST WITH HIGH SHARP BANK DUE TO RECENT CAVING.

FIG. 3. VARZEA WITH LOW BANK AND RECENT DEPOSITION.

parasitic plants which live on the trees high up in the light. The tangle of vines and trees is densest along the banks of rivers where light comes from the sides as well as from overhead and here the forest is impenetrable. The forest yields many products, the most important of which, commercially, is rubber. Many varieties of trees produce a form of rubber but the best is obtained from the *Hevea Braziliensis* by making incisions in the bark. Much of the timber of the forest is of great beauty of color and grain and has come into some use in cabinet work, but as yet the forest has been practically untouched. Palms are found in all regions, but the igapó is their home, and they are found here in many varieties, some of them the largest and most beautiful of the genus. They are among the most useful trees of the forest; the fruit of many is of value as food, the leaves are used for thatching, and fibres formed from the leaves serve the purposes of flax.

There are seasonal variations in the rainfall forming a long wet and long dry season, and between these a short dry and short wet season. There is a general rise in the rivers from March to June, with a slighter rise in December. Notwithstanding the great number of rivers and their depth, they are insufficient to carry off the volume of the water which falls in the rainy season and the entire region of igapó and varzea is flooded. The height to which the water rises in the floods in different localities varies greatly and seems to upset the laws of hydrostatics. This is due to many conditions, the most important being the general flatness of the region and the great tortuosity of the rivers. In the eastern end the flood rains come two months earlier than in the west; and in the northern part, which is drained chiefly by the Rio Negro, the rains are inter-

mediate. The rise in some places is enormous. At Manaos the maximal rise is a hundred feet and the usual forty to fifty. The valley becomes a vast sea and canoes pass through the forest. The inhabitants of the low lands take to boats or withdraw to the terra firme and thousands of cattle are drowned each year (Fig. 4). The flood is the time of scarcity owing chiefly to the wider distribution of the fish which renders their capture diffi-

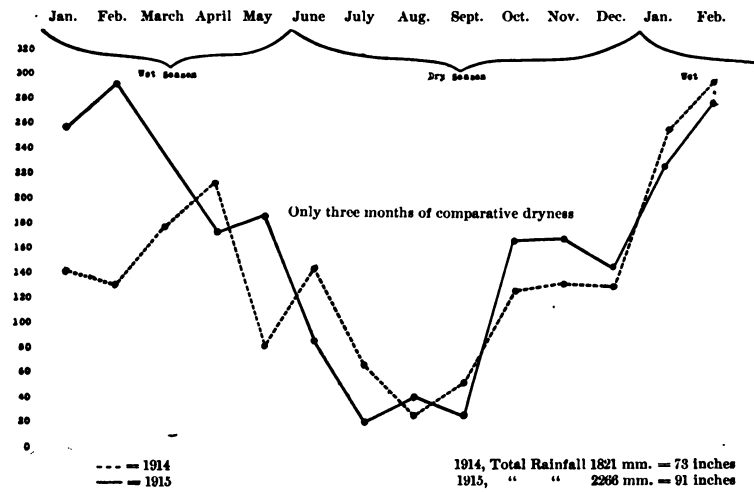
Jan. Feb. March April May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb.
Wet Season
Dry Season
Wet
Only three months of comparative dryness
--- = 1914
— = 1915
1914, Total Rainfall 1821 mm. = 73 inches
1915, " " 2266 mm. = 91 inches

FIG. 3A. RAINFALL AT MANAOS, 1914–1915.

cult, and the deprivation of the land. Mosquitoes and fever are more common at the end of the rainy season. Even during the wet season the rain is not continuous, it comes usually in the afternoon and is often of great intensity. The rainfall at Manaos for 1915 was ninety-one inches, and seventy-three inches for 1914.

The prevailing wind is in the direction of the trades, from east to west, and there is in general little wind movement. Storms are rare, of short duration, and local in their effects. The forest rarely shows tracks of storm,

and for the most part in the early morning and evening the waters show as perfect a mirror as a mountain lake.

Throughout this vast region communication is by water only; the rivers and tributary streams are so numerous that a large area is accessible. There are also many communicating streams between the rivers and lakes, open to steamer navigation. Extending from the rivers there are everywhere *igarapes* or canoe paths, which pass for long distances into the land. The extent

FIG. 4. TERRA FIRME. A SITIO OR PLANTATION ON THE AUTAZ RIVER.

of these waterways may be seen from the map (Fig. 5), which represents a small region above Monte Alegre; and the region of the Autaz river south of the Amazon through which one of us passed is very similar. There are no railroads in the region and no roads to be traversed by horse or vehicle save in the immediate vicinity of the larger cities and towns. Shallow draught steamers, usually propelled by a stern wheel and using wood for fuel, make trips to the head of navigation on the various rivers, the trip often taking several weeks. Most of these steamers are owned by English companies

and have headquarters in Pará, Manaos, and in Iquitos. In addition to the steamers, launches ply on the smaller streams, using kerosene for fuel. The steamers we have seen were comfortable, the food good and more than abundant. The region between the rivers is for the most part unknown and inaccessible. There have been hazardous explorations in certain regions, and paths made by Indians and rubber-gatherers extend inward for short distances only.

The valley of the Amazon is the most unchanged and unchanging great region on earth. It presents the same features as it did in 1539 when Orellana, deserting his commander, first came down the great river from the Kingdom of Quito, the Ecuador of today, and the description of the life of the Indians given by Acuña a hundred years later holds with few exceptions for today.

It is a solitary region and the longing of the poet " for a lodge in some vast wilderness " could be easily gratified. The usual estimate of the population is one to the square mile, but there is no accurate knowledge of the population, nor whether it is increasing or diminishing. Judging from Acuña's narrative in which he describes the villages along the Amazon as forming an almost continuous line, it is diminishing. There has been some increase in the population of such cities as Pará, Manaos, and Iquitos, but the population of the smaller towns, especially along the Rio Negro, is said by the best informed to be diminishing, and there is further evidence of this in the ruins of houses and churches. It is possible to travel in a steamer for an entire day without seeing a human habitation. The population is on the highway of the water courses. Here are the towns which with the exception of the cities of Pará, Manaos, and Iquitos, are of small size, rarely exceeding a thousand inhabitants.

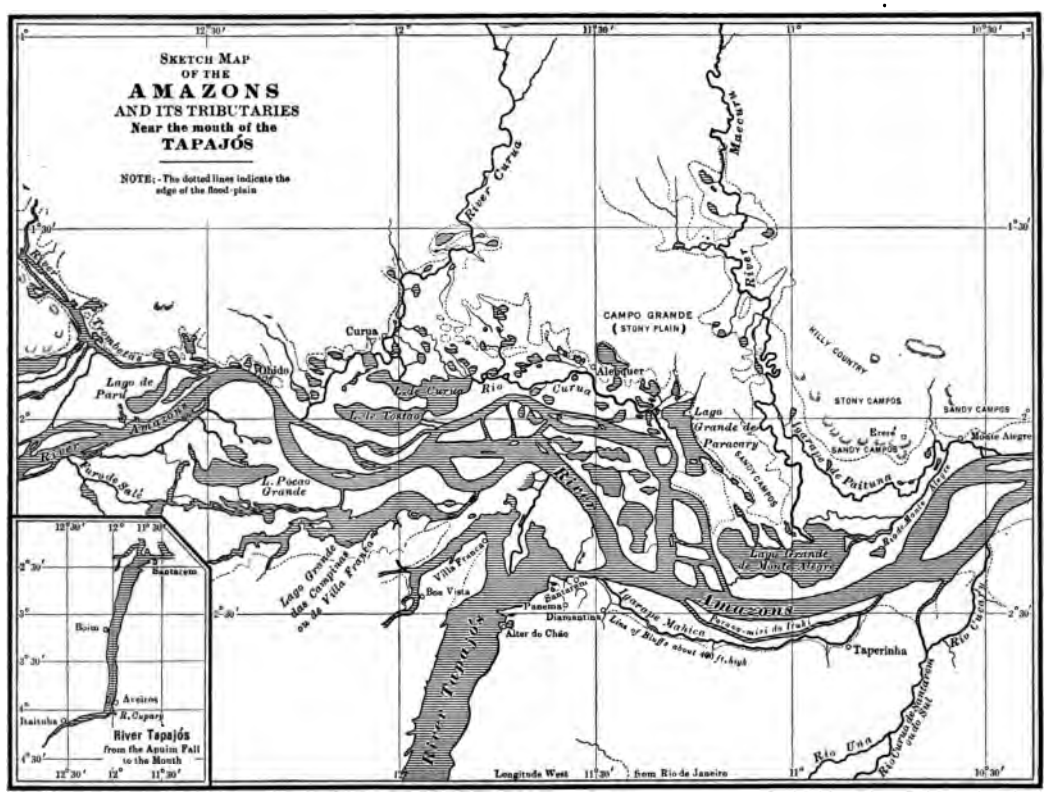

FIG. 5. MAP OF REGION ABOVE MONTE ALEGRE TO SHOW CHARACTER OF THE RIVER PLAIN AND THE NUMBER OF WATER COURSES. FROM H. SMITH, "BRAZIL, THE AMAZON, AND COAST."

There is some confusion in the statements regarding population in that the town includes an entire district of many square miles. There are sparse villages composed of palm thatched huts and scattered single huts (Fig. 6). Many of the towns and villages as seen from the river are exceedingly picturesque, situated as they generally are on high land with areas of grazing land about them, on which a number of forest trees of

FIG. 6. SAN GABRIEL ON THE UPPER RIO NEGRO. THIS IS AT THE FIRST RAPIDS AND WAS FORMERLY A TRADING STATION OF IMPORTANCE AND THERE ARE RUINS OF A FORT WITH SEVERAL ANCIENT GUNS.

great height and size have been allowed to remain when the land was cleared. There are many palms, single and in groups, and in the gardens around the houses are the broad leafed banana, pawpaw, bread fruit, and citrous trees.

Indians compose the bulk of the population and although divided into many tribes have a more or less interrelated language and common physical characteristics. They are generally short and heavily built, the

FIG. 7. PLANTATION INDIANS. ATTACHED TO A RUBBER PLANTATION ON THE RIO NEGRO.

FIG. 8. FOREST INDIANS OF THE MACU TRIBE. THIS IS A LOW-CASTE ENSLAVED TRIBE ON THE RIO NEGRO.

chest large and muscular, the arms, owing to their being a canoe people, more developed than the legs (Figs. 7 and 8). There is, however, much variation in the different tribes. The color is rather paler than that of the North American Indians, No. 4 of Brocas scale, the cheek bones not so high and prominent, the eye slits narrow and the whole cast of countenance is more of the Asiatic than the North American type. The hair of the male is abundant, coarse, straight, and black, lacking on the face and body. The hair of the female is abundant and much finer. Depilation of the body is practiced by both sexes.[1]

The Indians in all accessible regions are practically enslaved by the rubber merchants,[2] who have obtained from the government concessions of the land. They have become increasingly dependent, their agriculture and arts are being lost, and they receive for their labor rum, sewing machines, music boxes, and other useless products of civilization. They are in general a non-warlike, patient, and docile race, not lacking in intelligence, and these very qualities render their exploitation the more easy. In places remote from civilization dreadful atrocities have been perpetrated, dwellings burned, men killed, women and children carried off. The remote Indians, in regions where the toils of the rubber exploitation have not extended, live in *maloccas*, or community houses, hidden in the depths of the forest, and reached by concealed paths which extend from a river or a small stream navigable only for a canoe. The maloccas are often of great size, sheltering as many as two hundred

[1] It is quite striking how rarely one sees baldness in either whites or Indians in this part of Brazil, with the exception of the foreigners.

[2] The Indians represented in Fig. 8 are women from an inferior tribe of forest Indians who with their driver were on their way to the rubber regions.

inmates and are cleverly constructed of beams and poles lashed together with vines and covered with palm thatch. Within the common dwelling each family has its own fireside and independent life, the social organization resembling the "long house" of the Iroquois. There are cleared plantations in the vicinity of the malocca, the care and cultivation of which is entrusted to the women, while the men prepare the ground by cutting down and burning the forest, hunt, fish, and rest from their labor. Certain of the customs are also to the advantage of the male, as when a woman gives birth to a child the father goes through a period of rest in his hammock and receives delicacies and congratulations. Inter-tribal wars are common and have been one of the means of depleting their numbers.

Apart from the Indians the population is a heterogeneous mixture. The Brazilian population, originally Portuguese, has interbred freely with both negroes and Indians, the Indian half-breed mameluco being as a rule superior to the mulatto. There is a steady immigration of Portuguese who form an industrious, hard working population, and do most of the work. The population in the cities is extraordinarily varied, for the wealth coming from the rubber industry has attracted immigrants from the entire world and every nationality is represented among the prominent rubber merchants. As in other places, certain trades fall into the hands of different nationalities; the sale of dry goods by peddling is in the hands of the Armenians, and the very extended trade of prostitution is chiefly conducted by the Poles. Few of the whites, except those of the lowest class, engage in the actual collection of rubber or other forest products. On the land the whites generally live in villages or on large estates. The houses of these estates

are situated on prominent points of the rivers and surrounded by offices and farm buildings; life in many of these is on a feudal scale and a wide and generous hospitality is dispensed.

In addition to rubber the region produces gutta percha, sarsaparilla, tobacco, sugar, cacao, mandioca, piassaba fibre, nuts, and a variety of forest products, among them many valuable drugs. The chief exports are rubber, nuts, and sarsaparilla. The great wealth of the region, which has hardly been touched, lies in the timber, and as a source of natural wealth this can hardly be destroyed. There are many difficulties which lie in the way of its exploitation, the chief of these being the great variety of the growth. All of the wood has value as timber but the character differs so greatly that the unsorted lumber could not be used for a common purpose not even for the production of wood pulp. Doubtless, however, the time is approaching when the demand for lumber, with the rapidly decreasing supply, will compel the world to draw upon this seemingly inexhaustible source.

Life in the region is primitive in the extreme. Almost every house has a small plantation of mandioca (*manihot utilissima*) which forms the staple food. The roots of this, after being thoroughly washed and soaked, are grated on a rude grater of wood into which small sharp pebbles are inset, the mass of pulp is again steeped in water and the juice, which contains a poisonous principle, expressed. The resultant material is then dried or baked in a rude oven and crushed into grains of varying fineness. There are several varieties of the plant and the products differ correspondingly. It is eaten mixed with other foods or stirred in water to a thin gruel. In certain regions maize is used in the same ways

as by the North American Indians. No flour is made in the region, all of this or its products being imported. Coffee and cacao, the latter in large amount, are also produced. Save in the cities and on the large estates meat enters but little into the food. Fish are abundant in the rivers and of excellent quality, turtles are numerous and with their eggs, which are collected in large quantities, constitute one of the staple foods. Although great numbers of cattle are raised on some of the rivers, milk and dairy products except in the form of cheese, are rarely seen beyond the plantations. The principal vegetables outside of the universal mandioca are yams, beans, sugar cane, maize, and rice. Cabbage, which grows rapidly and never forms heads, melons, small and inferior, peppers in great variety of size, form, and pungency, are also raised in the gardens. Pigs are found almost in a wild state about the villages and houses; they live on the offal, the wild fruit, and nuts and receive no care save an occasional scattering of corn. Chickens also form a part of the domestic animals. Nearly every house has about it a few fruit trees; bananas, pineapples, oranges, mangoes, pawpaw, alligator pears, and bread fruit are the most common; the pupunha, or peach palm, the fruit of which is delicious and nutritive, the cucura, whose fruit is borne in clusters and resembles in flavor the black Hamburg grape, are less common. Cattle are not found save about the large plantations and villages where there are areas of grazing lands. With a very slight expenditure of toil an abundance of food of excellent quality is produced.

A sort of beer is made by the fermentation of both the sugar-cane juice, maize, and mandioca, but the general intoxicant all over the country is cachaça or rum, which is made and used everywhere. The rum is white, of

inferior quality and is used generally fresh from the still. There is no government tax upon the product nor regulation of its sale. It has been the principal means by which the degradation of the Indians has been brought about and to its unrestricted use the general low stage of development of the entire region is to be largely attributed. In addition to these alcoholic drinks coca and guarana, the latter containing a large amount of caffein, are used as stimulants.

In spite of the enormous tree growth covering the land, clearing is not very difficult and owing to the richness of the soil and the combination of this with heat and moisture, growth of all sorts is so luxuriant that a small area will produce a large amount of food. In clearing, all except the largest trees are felled and the immense mass of tangle which results is burned, taking days or weeks, and although the smaller trunks and vines are consumed the great fallen trunks remain until the more thorough work of fungi and ants causes their disappearance. The thickness of the bark of the great trees which are left standing protects them from the effect of the fire. These noble trees in a pasture of closely cropped fine thick grass, at all times a vivid green, with fine cattle standing in the grateful shade given by the crown of foliage often a hundred feet above, and with towering palms, single or in groups, which always seem to seek a situation with an eye to the picturesque, form a sight never to be forgotten.

Mammalian life is not abundant in the forest save in areas away from the rivers, and even edible birds are comparatively rare; though geese, ducks, and snipe are abundant along the upper waters of some of the rivers. With the exception of the herons, the interesting non-edible ciganas, the parrots and macaws, and the two or

three common varieties of small birds, such as parroquets and troupials,[1] all of which are seen along the rivers or in clearings, the traveller rarely sees a bird. In the forest they may be present but they live in the high roof invisible to the untrained eye. Of edible mammals there are tapirs, wild hogs or peccaries, monkeys, small deer, armadillos, and a few smaller animals of the rodent family. Starvation awaits every individual who attempts to live from the products of the wilderness, if away from the rivers. Much of the life is inimical or certainly unfriendly to man. Of dangerous beasts the jaguar only deserves mention, and though there are records of an unprovoked attack on man, the cases are so rare as to be negligible. There are very few dangerous and poisonous serpents. The boa constrictor is very rare, but has been known to attack man; and of the poisonous reptiles the most common are the jacaraca, the rattlesnake, and the coral snake, all more common in the uplands than in the river forests.

The Insects

It is when we come to the insects that the real enemies of man are encountered. They are the masters of the wilderness and they seek to extend their dominion over all who intrude. The most ubiquitous are the ants. No region, no home is free from them, whether in city or country, in forest or clearing. So far as can be ascertained, though troublesome and unpleasant, they convey no diseases. One of them, gigantic in size, an inch or more in length, the Tucandera or conga, is found chiefly

[1] The troupials give an interesting example of the use of a protective environment. The colonies of their long dependent nests are placed on trees which also contain the homes of the most venomous wasps of the region thus ensuring protection of the eggs from the monkeys.

in the forest, produces great pain and prostration by its sting,[1] and instances have been known of a number of bites resulting fatally. These ants never invade the houses. There is a small variety, well named "fire ant" from the effect of its sting, which has sometimes invaded villages and driven the inhabitants away. There are also armies of foraging ants which destroy everything which comes in their way. The most interesting are the Saüba or leaf-cutting ants which carry sections of leaves to their nests along narrow smooth paths which they form in the forest and fields. This material, after undergoing a preparation by chewing, provides a soil on which a fungus, which serves them for food, is grown. They select only certain trees for their depredations and are particularly fond of trees foreign to the region and which are cultivated, such as the cacao tree. The planter must wage a continuous warfare against them and they often show great ingenuity and perseverance in circumventing man's efforts. Nearly every flower which blooms in the forest contains ants which seek the nectar and some even have entered into neighborly relations with plants and are of mutual assistance.

[1] Spruce, vol. i, says of the Tucandera ants: "It was about 2.00 P.M. when I was stung and I experienced no alleviation of the pain until 5.00. During all this time my sufferings were indescribable, I can only liken the pain to that of a hundred thousand nettle stings. My feet, and sometimes my hands, trembled as though I had the palsy, and for some time the perspiration ran down my face from the pain. With difficulty I repressed a strong inclination to vomit. I took a dose of laudanum at four and I think this did more than anything to lull the pain. I had been stung on the two big toes, but the stings which caused me most suffering were four close together among the fine veins below the left ankle. When the pain of all the others had subsided this continued to torment me and pains shot from it all over the forefoot and up the leg, in spite of the bandages. The pain returned with great force at nine o'clock, and at midnight, and each time caused me an hour of acute suffering. The next morning there was numbness and the inflammation continued for thirty hours."

They excavate long tunnels in the earth, which extend with communications for hundreds of feet, they throw up long mounds of earth several feet in height, they form great nests high up in trees with covered galleries leading to them, or an entire tree trunk or house side may be covered with shaggy masses of material which form their home (Fig. 9). Many species are winged and form their nests high up in trees without communication with the earth. Their sting resembles the thrust of a red hot needle into the skin and though painful for the moment leaves no unpleasant after-effect. The skin is blanched over a small area immediately around the sting and a firm induration forms which shortly passes away. It is possible that in very tender skins vesicles may be formed by the exudate. In a house on the Autaz river small vesicles and superficial erosions were seen on the bare feet and legs of a child of four years, which the father said were caused by the stings of small brown ants, numbers of which were seen running about the floor. None of the other members

FIG. 9. TREE TRUNK COVERED WITH THE SHAGGY MASSES OF ANTS' NESTS.

of the family were so affected, although frequently stung.

There are also legions of wasps, many of them of great size and extremely venomous, who construct nests of complicated design, but who fortunately have as yet not learned to prey upon man, and with care can be avoided.

All travellers in the region regard the pium, a small biting fly, as a most troublesome insect. These are not more than 2–3 mm. in length and 1/2 mm. in breadth, the underside of the body is pale, the back black with a small glistening point between the wings which are not closely folded. The insect is extraordinarily active and its destruction or capture not easy to attain. It alights, runs around quickly until it finds a suitable spot, then quickly bites and fills with blood, and only when in the act of sucking is capture possible. A hard swelling, 5 mm. in diameter and 2 mm. in height, is produced and in the centre of this is a perfectly round spot of hemorrhage 1/2 mm. in diameter. The itching is intense and when the bites are numerous there may be considerable diffuse oedema, due probably to the combination between bites and scratching. Protection can be attained only by close meshed head nets and gloves; citronella oil is efficacious for a time but must be frequently renewed and is itself irritating to some skins. The piums are not widely distributed. The head waters of the black water rivers are favorite localities and the Rio Negro and Casiquiare Canal have enjoyed an unpleasant notoriety in this regard. They are confined to the banks of the rivers and are never seen in the adjoining forest. They were very numerous and troublesome when we were camped at Camanaos, just below the rapids of San Gabriel, and it was a great relief to pass

from the heat and glare of the sand bar into the cool twilight of the forest, where the only insects were the ants. The areas on the rivers most favored by the piums are shores of sand bars and rocks with swift current; they may be in great numbers in one locality and absent in another, although the same conditions may be present. There is no acquired immunity to the effect of their bites, natives and Indians suffering equally with strangers. There is a very general belief that the irritation following the bite may be lessened by puncturing the small spot of hemorrhage and squeezing out the blood which lies in a small cavity in the corium, but like many therapeutic procedures it does not prove effective. The pium is a day insect, arising promptly with the sun and most active in the early morning after the repose of the night. There is a very general belief that the very common ulcers seen in the region are produced by them, but in the absence of experimental evidence, this may be questioned. We found no typical Leishmania ulcers in the natives of the regions where the piums were most abundant. At San Isabel the storekeeper was so severely bitten that the bare feet and ankles looked as though black pepper had been sprinkled upon the skin. There was also some diffuse oedema, vesicle formation, suppuration and superficial ulceration, but the condition bore no resemblance to the Leishmania ulcer, and responded readily to cleanliness and simple treatment. The habit of stockings would be a valuable innovation where the piums abound.

More tormenting even than the piums are the micuims.[1] These are so small as to be just visible to

[1] This insect, whose life history is known not at all or imperfectly, is a larval form of a species of *Trombididea*. It has received different names in the various places where found, and the name here used is probably a per-

the naked eye when on a surface of contrasting color. They are a bright orange in color and when collected on a white stocking this looks as though covered with red pepper. They move with such rapidity over the skin that it is difficult to keep one within the field of a lens, and having selected a point they quickly penetrate within the epidermis by a boring motion, the insect constantly turning. No irritation is felt at the time, but shortly great indurated wheals several centimeters in diameter are formed, often with a small vesicle in the centre, and the itching is intense. No other experience can be compared with it, and it seemed impossible that an insect so small could have such an effect. The insect could frequently be recovered just within the epidermis in the centre of the wheal, but there was no evidence that ova were deposited nor did they seem to undergo here any further metamorphosis. They are very generally distributed throughout the region, chiefly in the pastures, and are much worse in the dry than in the wet season. They attack the cattle who do not seem to be at all bothered by them, and it seems probable that man is only occasionally a prey and the peculiarly virulent character of their poison is not really meant for man but to reach through the far thicker epidermis of the cattle who may have some additional protection in a partial acquired immunity. In man there seems to be considerable individual variation in susceptibility to their effects. The two individuals of our party who suffered most were blonds, but at the same time these were most exposed, one by his work of erecting stations for wireless operation and the other from his habit of wandering

version of Mouqui, by which it is known in Peru. It is soft-bodied, with six legs provided with claws and has a powerful hypostoma which it drives into the skin.

over the fields to satisfy curiosity. They are much more numerous in certain places than in others, and in the older pastures rather than in the newly acquired. At one large sitio where we spent several days it was necessary to cut paths in the turf, leading from the house to the various farm buildings, and the family was anxious to sell the property and move away on account of them. There is no protection against them, for they can easily find their way to the interior through the openings of clothing or even pass directly through it.[1] The areas of skin most attacked were the waist region, the buttocks, and the thighs, they seeming to select those parts least susceptible to scrutiny. They can be partly avoided by removing all the clothing when coming from a walk and washing the body in strong rum, which kills the insects in contact with it. We found that the best means of allaying the intolerable itching was an application of corrosive sublimate, 1–1000.

Of much less importance than these two main pests are the meruim, a tiny fly much resembling the gnat of Canadian rivers, which bites but leaves no effect, and the matuca which bites fearlessly and fiercely both animals and man, but which is not poisonous. Scorpions and centipedes are numerous in some places, but we did not encounter them. Spiders are numerous but did not seem to be harmful.

There are some compensations. The ordinary house fly is absent, nor do carrion flies seem to be present. During our residence in San Gabriel swarms of small black flies were attracted by sugar spilled on the floor, but they were not troublesome, and like dinner guests

[1] High boots give no protection, for they quickly pass beyond the tops of these. It is not improbable that some measure of protection might be gained by a band of some sticky material around the boot just as trees are protected against the ascent of gypsy moth caterpillars by such a band.

disappeared after the feast. All conditions seemed to be present which would favor the life of the house fly and it seemed to us that probably the reason for their absence lay in the destruction of their larvae by ants. So far as I know, however, no proof of this has been shown. There are no privies in the region save in the cities, but about the houses and villages there is little or no evidence of soil pollution, all faeces being removed by the ants in a few hours.[1] In the pastures also the large faecal masses from the cattle remain but a short time and the small grass clumps which in our pastures denote past deposits are not seen. On the river banks the cattle often lie in the warm sand at night, and here where ants are absent the faeces remain until they dry up. Although dead animals must be not uncommon, there is no smell of carrion, for the buzzards and ants quickly care for a carcass. There are no flies in the pastures to bother the cattle, which to some extent accounts for their good appearance and apparent contentment. The matuca, which does bite them, is confined to the river shores. We have never seen mosquitoes about them, though possibly as the mosquito here is a nocturnal insect they may bite them at night.

It is interesting in placing insects in the order of importance of their immediately unpleasant effects that the mosquito should come last. The yacht was thoroughly screened, but on the long voyage up the Amazon and return, during a great part of which both luncheon and dinner were served on the open deck, they were practically absent save on one or two occasions on the upper river when we were at anchor close to the bank.

[1] The rarity of typhoid fever in the cities and its practical absence in the country may also be due to the action of the ants as general scavengers. However, even if this be true, it is a large price to pay for immunity.

In the cities we never saw them during the day but in the hotel at Manaos I was several times bitten at night, though under a mosquito bar. We have many times been along the river shores in swampy land, partly overflowed, on shallow lakes, in short in many places where similar conditions with us would have made such excursions martyrdoms, without seeing, hearing or feeling a mosquito. On the river boat which conveyed us from Manaos to San Isabel we ate on the open deck, sat in the evening on the deck, and slept in cabins without nets and were not troubled. The boat, however, had been thoroughly renovated and cleaned before leaving Manaos. At San Isabel, although the other pests were in full force, mosquitoes were not felt, although in walking through the grass in the evening a few were seen rising, and embryos were found in the water collected in the bottom of an old canoe. This is at variance with the ideas held and with the reports of travellers, and is to a certain extent due to the period of the year in which we were in the country. The relation of the mosquitoes to the river travel, and to malaria will be taken up elsewhere.

The Smaller Towns on the Amazon

High up on the Amazon above the Rio Negro there are a number of small towns which we did not visit and which are inferior in size and importance to those lower down. These towns, such as Tabatinga, Teffe, Fontaboa, Coary, are rarely visited by strangers and are known from the early explorers who spent some time in each of them. They are usually situated on high ground on the bank of the river where there is an entering affluent. They are the headquarters of the trade of the region and as far as can be learned they present about

the same conditions as far as health is concerned as the lower towns.

The general impression given by these Amazonian towns is that they are comparatively healthy and have in them the conditions which might give a pleasant life. They have malaria but this does not seem to be a grave form, certainly not like the type we saw on the lower Rio Negro. All of the accounts given of the Amazon bear this out. The grave forms of fever are found not here but high up on the tributary rivers. Of course such cursory visits as ours could determine very little of health conditions; there are no vital statistics of the region, and if there were they would be unreliable. The appearance of the people has some value, and from this we should say that the region is fairly healthy, and the conditions for existence easy. Certain diseases common with us seem to be rare. We rarely saw a tumor, or any cases evidently tuberculous, nor were there superficial evidences of uncinariasis in high degree anaemias. Of the prevalence of insect plagues we could not judge for our stay was too brief, certainly we were not troubled with mosquitoes or other insects. The shore conditions along the Amazon river are not favorable for piums, and several members of the party who made at Monte Alegre and Santarem long excursions into the country did not acquire micuims, but these, however, are pretty generally distributed throughout the valley. There is almost an utter lack of physicians, in some of the towns there are none and of course none in the country.

The Towns of the Lower Amazon

Monte Alegre (delectable mountain), the name being derived from the nearby low mountains which are a continuation from the mountains of Guiana, was the

first of the Amazonian towns visited after leaving Pará. It is situated not on the Amazon directly, but on the bank of a smaller river eight miles from its mouth. A steep hillside three hundred feet in height, rising to a broad plateau, divides the town into an upper and lower part. The lower town lies along the river and consists of a long street facing this and several short streets at right angles. The upper town consists of a large open square with the church and a number of houses on its sides, all the houses small and of inferior construction. There are springs high up on the hillside, the water from which is conducted into the town. The country back of the town is high campo and is given over to cattle raising and farming interests. There was the unusual spectacle of horsemen riding along the streets.

The day of our arrival was a holiday and there were a large number of people in the town. Specimens of blood were taken from twenty people. Eighty per cent of those examined gave a history of malaria and all but two had been well treated by a pharmacist with injections of quinine hydro bromate. Unfortunately we did not examine for enlarged spleens, but we did not notice any children with prominent abdomens, so common a sight on the Rio Negro, nor did any of the people complain of this trouble. The people were healthy looking in spite of the fact that so many gave a malarial history; for example, in a group of fifteen who were questioned but whose blood was not examined, twelve gave a history of malaria (Fig. 10). The pharmacist said that malaria was very prevalent, especially in late summer, August, September, October, and November; there was less in the winter or wet season, although mosquitoes are worse at that time. Severe and fatal forms of malaria

were occasionally met with but quinine usually effected a cure. We learned that diseases other than malaria were rare and we saw none save a man with keratitis, probably due to syphilis. The infant mortality was said to be high. We found a number of persons who spoke

FIG. 10. VIEW OF INHABITANTS OF MONTE ALEGRE. THE INN-KEEPER IN THE FOREGROUND, THE WRESTLER IN DOORWAY.

English and who acted as interpreters, among them a very stalwart Syrian who had come down from Manaos for a brief holiday and who said he was the first among wrestlers of the second class. There is no hospital. Tertian parasites were found in two of the cases examined.

OBIDOS

This is a town situated on the high bank of the Amazon about five hundred miles from Pará; the population three to five thousand. The situation is very picturesque, the tile roofs of the houses and the church standing

out amid a forest of palms and other trees. The narrowest part of the river is here, the greatest depth and the most rapid current. The yacht anchored in twenty-five fathom of water, three hundred feet from the bank. We first called upon M. Paul Le Cointe, a French gentleman who had married a Brazilian wife and who had large plantations on the river. He is a naturalist, well known for his contributions, a collector of objects pertaining to the anthropology and natural history of the region, and has received the medal of the Legion of Honor. He has a large house and a beautiful garden, in which in addition to plants peculiarly tropical are many roses and our ordinary perennials and annuals. All these familiar flowers were inferior to the same in our gardens. It was Sunday and we probably saw most of the population on the streets, in the cathedral and about the football ground in front of the cathedral, where a ball game was in progress. The people generally looked healthy and well nourished. Six blood examinations were made, one of them positive, the organisms young forms of tertian.

Itacoatiari

This town, the old name Serpa (Fig. 11), was visited later on the trip to the Autaz. It is situated on high ground on the north bank of the Amazon, almost opposite the Madeira river and it was supposed that it would have a large trade in connection with the Madeira and Marmore railroad. It was formerly a rival of Manaos but has declined in population and in importance. It is a small and beautiful town of about two hundred houses and back of it is a fine agricultural country which produces corn, cattle, tobacco, cacao, etc. The principal trade is in Brazil nuts, immense quantities of which were in barges moored in the river. We were shown also the

sapocaia, a thin-shelled delicious nut which rarely enters into commerce. There was no physician in the town but from conversation with one of the merchants who had

FIG. 11. ITACOATIARI FROM THE RIVER.

lived in Philadelphia for some time we learned that the place was in point of health similar to the other towns; fairly healthy, some malaria always but more at the end of the rainy season. No mosquitoes were seen.

SANTAREM

Santarem (Fig. 12), six hours distant from Monte Alegre, is situated on the Amazon at the entrance of the Tapajos river. The Tapajos is a black water river and its entrance into the Amazon is marked by the usual sharp line, the admixture of waters taking place slowly. The two streams seem to struggle at the line of junction and masses of the two waters boiling up from below make mutual inroads. The town is divided into two parts, one containing the business houses and more pretentious dwellings, and the other chiefly composed of palm houses straggling up a hillside. There is a cathedral presided over by a bishop whose house adjoins. On landing we visited one of the physicians of the town, Dr. Nelto, whom we found to be a very courteous and

cultured Spanish gentleman. He lives in a large and comfortable house with wide central hall and big rooms, all paved with tile. In the absence of an interpreter conversation was difficult, but we managed to explain the object of our visit and to ask a few questions. He said there was little sickness just then, the morbidity being greater in the wet season (we were told the opposite in Monte Alegre). The commonest diseases are malaria and uncinariasis. Leprosy is prevalent and there is a leper colony on a nearby island. There is some

FIG. 12. SANTAREM. THE CATHEDRAL AND RESIDENCE OF BISHOP ON THE RIGHT.

paratyphoid but no typhoid, as shown by agglutination tests done in Pará. We felt very uncertain about this as there is no public laboratory in Pará where such tests could be made. With the doctor we went to see two of his patients, both with continued fever, listless, weak, presenting the appearance of typhoid. There seems to be a curious custom of having the patients brought in to see the doctor who remains in the sitting-room with the family and this seemed to entail much hardship on both of the patients.

We then called upon the bishop, an intelligent German, who with several Franciscan fathers lived at a house next to the cathedral. He has lived in Brazil

twenty years and previously was stationed in Bahia and Pernambuco. He considered the country as a whole very healthy but thought that leprosy was on the increase. The government pays but little attention to the colony of lepers who fared better in the days of the empire. He confirmed the doctor in saying there was more sickness in winter (the rainy season) than in the summer. The people congregate in the town in the winter and go out to the farms in the summer. The bishop makes extensive trips visiting the Indian missions, often travelling hundreds of miles in canoes. He told us that the essentials for safety in such travelling were a life preserver always worn in a canoe, for these vehicles lack in stability, a hammock with mosquito bar, and quinine. The cathedral contains a tablet placed there by the King of Bavaria as a thank offering for the miraculous preservation of the life of the botanist Martius, who was overturned in a canoe near the town.

The population of the town is from five to seven thousand, always greater in the wet season. We examined the blood of six people, including the fever patients of Dr. Nelto, and all were negative for malarial parasites. The spleens of these persons were not examined, but on the return trip seven boys were examined and none of these had a palpable spleen.

The Cities of the Amazon

Pará (Fig. 13), about one hundred thousand inhabitants, the capital of the state of Pará, which comprises the eastern half of the Amazon valley, lies on the Pará river, a great estuary which is connected with the Amazon by numerous channels and formed by the Tocantius and a number of smaller rivers which empty into it. The city is flat, probably at no place more than

forty feet above tide level; the newer part is well laid out in avenues with streets at right angles, but the older part around the water front is more irregular. Formerly yellow fever was endemic and caused yearly a great mortality, but this has now been done away with by the modern methods of control. The streets generally are clean and are planted with mangoes and a very beautiful fig with small, clean, glistening leaves, a very much better tree for tropical cities than the more picturesque

FIG. 13. PARÁ. THE WATER FRONT.

banyan, which is also a fig. Formerly the chief tree used for shading the streets was the mango, a beautiful tree giving dense shade but producing much litter, and the irregularities of the trunk allow small accumulations of rain water, in which the yellow fever mosquitoes were said to breed. The mango, however, has the advantage of giving an important food supply by its abundant fruit. The matter of trees in tropical cities is of great importance, for they add greatly to the attractiveness of the city and the comfort of the inhabitants. The fig used here (*Ficus Benjamani*) with its symmetrical round crown, its fine, clean, glistening foliage, the interesting aerial roots which form attachments with the trunk,

and the fine color of this, makes it the best tree for street planting which we have seen.

There are many public squares in the city, generally well planted and cared for, containing handsome palms and flowering shrubs. There is a small park of about thirty acres, easily accessible by tram, and containing numbers of fine forest trees, many of which can be seen in their full proportions as much of the lower forest growth has been removed. Two miles from the city is a more extensive park where the original forest has been left intact save for the cutting necessary for the few paths. There is a museum founded by Goeldi in 1894 which has a good library and is rich in objects representing the anthropology and natural history of the Amazon region. The garden contains an interesting collection of palms and other trees and a very good collection of the fauna of the region, all well cared for. The whole is under the charge of Dr. Schnetlage, who has herself made a number of explorations and important contributions to knowledge.

The climate is agreeable, though warm, the thermometer ranging between 80° and 90°, rarely exceeding these temperatures. The rainfall is large, without great variation between the wet and dry season. The mornings are generally warm, but hard showers in the afternoon bring a grateful coolness which lasts through the night. The temperature in the two periods we were there, December and April, though warm was not uncomfortable except during one morning when we made an excursion to the forest (91°). High temperature is recognized as a constant condition and adjustment to this is sought in clothing and housing. Underwear is generally discarded and clothing resolves itself into pantaloons, shirt, coat, stockings and shoes, and frequently

one or more of these seeming essentials are discarded. The convention in regard to the coat is firmly held, it must be worn on the street, and a coatless man is relegated to the last seats in a tram car, among the laborers. An adjustment of the body to a constant high temperature seems to take place rather quickly, after which the heat does not trouble. The brilliancy of the sunshine, the extreme amount of light, is at first more unpleasant to bear than is the heat, but here also adaptation soon comes.

Pará, under the old name of Belem, which there is some attempt to restore, was formerly much frequented by the tuberculous, an unfortunate choice, for to a climate most unsuitable for this disease were added the dangers of yellow fever and malaria. The people, as seen on the streets and in the shops, the soldiery and the police struck us as being undersized. They do not look happy, there are few smiles and little laughter. This, which was very noticeable on our first visit, did not strike us on our return, for we had become accustomed to it. The Portuguese sailors and laborers (immigrants) are large and muscular men, but possibly less so than the average American laborer. There is no evidence of extreme poverty and beggars are rare. The people were said by Dr. Schnetlage to be extremely kind to one another. A somewhat limited experience in the tropics seems to show, in Anglo-Saxon women, a tendency to thinness in contrast to those of their sisters who have felt even remotely the touch of the tar brush. The population embraces many nationalities and there are all sorts of admixtures with the negro.

Pará was the first city founded in Brazil and it has played an important part in the history of the country, particularly in the first half of the last century, when

the monarchy was founded and the country became independent. It will further always be known from the writings of the remarkable group of explorers who studied the Amazon region about the middle of the last century. Martius, Bates, Spruce, Wallace, Agassiz, all spent some time here. When Bates was here in 1847 the city stood on the edge of the primeval tropical forest, which is now represented only in the large park at the water-

FIG. 14. THE PUBLIC HOSPITAL OF PARÁ.

works. He lived at St. Nazareth in a small house at the edge of the forest which has now disappeared. His descriptions of the forest as he then saw it apply perfectly to the conditions seen in the large park.

Pará has an excellent public hospital (Fig. 14), not only the best in the Amazon cities, but one which will bear comparison with municipal hospitals anywhere. It is a large, well constructed stone building, in the eastern section of the city, and with its garden and courts covers an entire city block. There are twelve wards, each containing thirty-five beds, giving accommodations for at least three hundred and fifty patients.

The wards are large and airy and open into a long corridor by folding doors. It was remarkable to see no screens and yet an entire absence of flies and, certainly during the day, of mosquitoes. In the courts between the wards (Fig. 15) there are well cared for gardens with handsome palms and quantities of flowers; every window looks upon a pleasing scene. It is under the care of a sisterhood, is scrupulously clean, and the

FIG. 15. PUBLIC HOSPITAL. COURT BETWEEN WARDS.

patients are well cared for. There are good operating rooms, X-ray rooms, and the general equipment in instruments and appliances is good. There is, however, no pathologist and no system of resident internes, and post mortem examinations, so important for stimulating the scientific spirit and general morale of a hospital, are not made. The hospital is supported by the free will offerings of the people through a hospital association with initiation fees and yearly dues, to which every person who can afford it belongs. We were told that membership in the association confers a certain social

prestige. Dr. Utra Vas, who is the chief surgeon of the hospital, was very kind and showed us the cases in the wards. The doctor was educated in England and in Germany and speaks both languages with facility. He has large offices, well fitted with modern appliances and a number of assistants who take care of the laboratory examinations and do much of the special work, the whole forming a well organized surgical clinic (Fig. 16). In

FIG. 16. INTERIOR OF WARD. THE BEAUTIFUL FLOOR IS FORMED OF ALTERNATING BOARDS OF ITAUBA (BLACK) AND AMARILLA (YELLOW) WOODS WHICH ARE ALMOST INDESTRUCTIBLE.

the wards we saw a number of types of the Leishmania ulcers which were treated with hypodermic injections of antimony, and a number of cases from the rivers with the immense spleens with which we had become familiar.

We append what health statistics we have been able to acquire, together with other data. The records of later years are not accessible. The estimate of population is certainly erroneous, for the cities here see their population under a magnifying glass, a fault to which those of other countries are not immune. The statistics

are probably not very reliable as is shown in the variations in the number of deaths from certain common diseases. The very low incidence of tumors is in accord with our observations everywhere we went. The very striking decline in mortality from yellow fever is the result of preventive measures instituted in 1911. The average yearly temperature and rainfall is given for but two years.

Year	Population (estimated)	Average temperature	Rainfall in inches
1907.....	185,000		
1908.....	185,000		
1909.....	185,000		
1910.....	190,000	80.9° F.	107.21
1911[1].....	190,000	80.4° F.	100.4
1912[2].....	200,000		

[1] All data for the years 1912, 1913, and 1914 were obtained from the *Office International d'Hygiène Publique* annual reports for those years. All other data, with the exception of the population estimates for the years 1907, 1908, and 1909 obtained from the consular reports, were taken from the *Annuario de Estatistica Demographo-Sanitaria* for the years 1910 and 1911. These two reports were published in 1913 and 1914 respectively.

[2] The 1911 report of mortality statistics combined certain causes as indicated in the chart on pp. 44 and 45.

Mortality Statistics of the City of Pará (Belem)

Cause of death	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914	Total
1. Typhoid fever	..	..	..	..	..	20	29	5	7	..	4	6	1	8	2	3	..	..	..	85
2. Typhus fever	..	..	..	..	..	..	..	..	1	..	..	1	..	1	..	..	..	..	..	3
3. Malaria	340	529	567	950	823	691	561	611	721	787	539	578	697	1159	886	713	..	..	..	11,152
4. Smallpox	30	56	4	189	123	90	2	..	225	426	34	253	12	3	29	18	..	..	..	1,494
5. Measles	43	26	2	181	11	1	..	..	..	53	1	10	1	..	62	..	..	..	..	391
6. Scarlet fever	..	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	2
7. Pertussis	9	15	1	13	15	15	15	..	33	7	30	11	..	..	..	5	..	..	..	171
8. Diphtheria and croup	2	2	4	12	17	5	4	..	3	9	6	5	8	1	4	2	..	..	..	84
9. Grippe	..	..	..	..	6	..	..	..	3	13	7	15	3	9	20	1	..	..	..	77
10. Cholera, asiatic	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...
11. Cholera, nostras	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	...
12. Yellow fever	138	340	222	391	466	131	145	130	191	183	253	193	213	169	352	37	..	1	1	3,536
13. Plague	..	..	..	..	..	..	..	..	..	..	..	35	3	9	4	16	19	..	..	86
14. Other epidemic diseases	266	175	126	192	253	110	110	170	336	132	218	39	29	37	68	42	..	..	..	2,303
15. Pulmonary tuberculosis	196	296	228	313	288	278	263	336	334	350	319	407	462	422	441	444	..	..	..	5,377
16. Tuberculous meningitis	..	..	..	..	..	2	..	..	..	..	..	..	..	..	2	..	..	..	..	4
17. Other tuberculosis	..	..	..	..	12	17	52	..	23	..	33	26	9	10	23	32	..	..	..	237
18. Cancer and other malignant tumors	14	21	15	19	12	16	15	24	31	24	30	49	45	40	40	35	..	..	..	430
19. Meningitis	13	24	36	48	20	61	49	46	41	40	50	41	34	39	74					
20. Congestion, hemorrhagic and softening of brain	44	47	47	44	41	74	57	51	58	56	67	74	52	85	68	173	..	..	..	...
21. Organic heart diseases	208	192	181	233	104	126	142	193	194	54	156	152	188	192	221	229	..	..	..	2,765

22. Bronchitis, acute	35	60	56	74	19	39	42	50	66	40	69	41	38	41	79					
23. Bronchitis, chronic	..	..	..	..	..	10	3	..	2	..	7	3	..	2	1					
24. Pneumonia	31	46	19	79	19	30	22	98	52	69	43	71	49	51	81	381	..	..	..	...
25. Other diseases of respiratory system	58	66	79	189	55	80	94	12	76	164	155	164	128	151	216					
26. Stomach affections, except cancer	2	8	10	6	3	..	11	8	7	8	6	..	2	1	3					
27. Diarrhea and enteritis (under 2 years)	..	..	..	..	..	9	..	..	36	411	397	439	436	358	508	561	..	..	..	...
28. Hernias and obstructions of intestines	..	..	..	..	..	..	13	12	9	14	10	10	15	4	3					
29. Cirrhosis of liver	17	22	28	29	10	64	40	75	56	28	51	43	40	68	44					
30. Nephritis and Bright's disease	25	36	44	77	20	43	32	40	32	44	65	56	70	61	101	69	..	..	..	815
31. Tumors not cancerous and other affections of female genital organs	..	..	..	..	..	..	1	2	..	4	6	12	1	..	..	..	..	..	..	...
32. Puerperal septicemia	6	10	10	13	16	6	21	..	21	13	21	18	9	21	18	19	..	..	..	222
33. Other accidents of pregnancy	..	..	..	..	..	32	23	36	1	12	14	18	19	17	13	4	..	..	..	189
34. Congenital debility and malformations	38	41	46	105	34	75	134	224	99	122	136	93	141	110	93	123	..	..	..	1,614
35. Senile debility	13	9	8	11	23	19	26	15	40	19	38	33	23	24	14	8	..	..	..	323
36. Violent deaths	48	39	45	36	56	63	57	46	58	35	59	64	78	81	92	101	..	..	..	958
37. Suicides	..	..	..	..	..	..	..	..	..	5	3	8	..	..	..	..	..	..	..	16
38. Other general diseases	1116	875	809	1312	1785	1177	737	682	1268	960	712	736	816	783	704	660	..	..	..	15,132
39. Cause not specified	..	..	..	..	82	69	64	25	286	18	54	35	..	..	..	..	..	..	..	633
Total Deaths	2692	2935	2587	4516	4313	3353	2764	2891	4310	4100	3593	3741	3622	3957	4266	3681	3704	..	..	...

Manaos

Manaos, known formerly as Barra, has a fine situation on high ground on the north bank of the Rio Negro, nine miles above the entrance of this into the Amazon. The Rio Negro is a clear black water river and there is a sharp line marking the junction of its waters with the turbid yellow stream of the Amazon, which can be followed for many miles. The city is the centre of the rubber industry of Brazil and during the period of high prices for rubber which was terminated by the present war, was very prosperous. Most of the steamers which serve the river traffic of the central and most of the western part of the Amazon valley make this their home port. The city is not lacking in picturesqueness; there are handsome wide avenues well planted with fig and mango trees, the public squares are numerous, beautiful and well cared for, but there is no public park. The theatre, situated on the highest land in the city with a dominating dome of blue glazed tile forms the most conspicuous object and focuses the civic pride. The building is poorly constructed and in bad taste. There are some very good public buildings and the foundations of others, the funds appropriated for their construction having disappeared before the buildings could get higher. There is a dignified old cathedral in the middle of a fine square, but the whole city is very different from the quiet and dignity of Pará and gives one the impression of a rapidly developed frontier town seen in its most unfortunate time, that is, at the decline of a period of great expansion. The rise of the city really dates from 1807 when the capital of the province was transferred from Barcellos here. In 1829 when Mar was here he estimated the population at three thousand. It increased

rapidly with the rise of the rubber industry which reached its acme in 1913–14. Great wealth flowed into the city, and with this came adventurers from the entire world to share in the prosperity. Even now there is probably no city of its size with such a cosmopolitan population.

The hospital is an old structure totally inadequate and dirty. Mar speaks of the hospital as a spacious

FIG. 17. COURT IN THE MANAOS HOSPITAL.

structure which had just been completed, and no doubt it then and for a considerable period fully sufficed for the needs of the city. It is rather curious that at a time when there was much yellow fever in the place some of the money expended in the costly and showy theatre should not have been turned to giving better conditions for the sick (Fig. 17). The only circumstance favorable to the hospital lies in the statement of the physicians that it was formerly much worse than at present. In addition to this public hospital there is a smaller hospital, called the Portuguese, which is

entirely for pay patients, is well provided and seemingly well managed. It is conspicuous from the harbor, standing on an eminence and still shows the ruin produced four years ago when it was subjected to a bombardment from a government man-of-war in the harbor. This was on the occasion of a gubernatorial election when the local authorities were not in full sympathy with the government. A small military hospital

FIG. 18. MANAOS MILITARY HOSPITAL.

(Fig. 18) stands just outside of the city. On either side of the city there are igarapes which extend a considerable distance inland, and in the expansion which the city underwent during the period of prosperity streets were run across these ravines without adequate provision for drainage, leading to the formation of large pools which served for mosquito breeding. The banks were endemic foci for yellow fever.

The city offers an interesting example of what may be accomplished by one man with the great possessions of knowledge, intelligence, public spirit, and energy. This rare combination has enabled Dr. H. Wolferston Thomas

to accomplish the wonderful work he has done here. Thoroughly trained in the Liverpool School of Tropical Medicine, and with an accomplishment of valuable researches in this field, his work has been accurate, scientific, controlled by laboratory and experimental methods, and he is untiring. He is physician, counselor, and friend to the English colony, extends his influence in all directions in which he can be of service and he has won the respect and admiration of the local physicians and the people. Such an accomplishment by a man working alone without the sympathy and encouragement which come from association with men engaged in similar work is remarkable. He lives in a house which combines in it a small hospital. During the prevalence of yellow fever he was very successful in its treatment, the essential principle of which was the ingestion of vast quantities of carbonated water. The measures for the eradication of the disease undertaken in 1913 were under his direction.

There seems to be a good deal of leprosy. Early anesthetic forms of this were seen in the general hospital and there is a small leper colony a few miles from the city where twenty-four cases are segregated. As this seemed a small number the question was asked whether these were all the cases in the district, and the reply was " Why no, there are possibly one thousand." The cases seen were advanced tubercular and mutilating forms and probably only the most advanced and evident cases are sent here to be cared for. The colony is well placed on high land on the bank of the river, there are abundant fruit trees and vegetable gardens, the small necessary care of which is given by the lepers, the river furnishes fish and the cost of the asylum is small. The buildings, though adequate, are mere shacks. One man, who

seemed to be of a somewhat higher social status than the others, lived alone, had his own garden, fruit trees, and poultry, which he tended, and the palm house (Fig. 19) which he had built himself was well constructed and clean. He has directed that when he is dead the house shall be burned with his body.

The city has an excellent and adequate water supply. The abattoir system and the distribution of meat is

FIG. 19. LEPER AND HOUSE WHICH HE HAS BUILT.

interesting and the same in the three Amazonian cities Pará, Manaos, and Iquitos. Cattle are very abundant and cheap. They are brought to market directly from the pastures, and when alive seem to be in good condition, but when slaughtered the meat as seen in the markets has not an appetizing appearance. The blood seems to undergo rapid hemolysis and all the flesh has the diffuse hemoglobin stain. The cattle are killed in the abattoirs after four o'clock in the afternoon and the meat distributed to the markets and provision stores

during the night, being carried either by bullock carts or as in Pará by the tram cars. No fresh meat can be sold after 11 A.M., and there is a rapid fall in price as this hour is approached. It might seem that an improvement could be effected by keeping the meat in cold storage for a couple of days before consumption as all of these cities have local ice plants.

Milk, both in the cities and in the country, plays but a small part in the food of the people. It is all boiled before using and is not a pleasant drink. In the Autaz region, where the raising of cattle is the main industry, there was considerable consumption of milk in the form of menhada, or clotted milk, which was delicious. Both in Manaos and in Iquitos we saw goats driven along the streets and milked at the house doors, the product being used for children. In Itacoatiari we saw early in the morning the conventional milk cart dispensing milk from a large tin receptacle.

HEALTH REPORT. — CITY OF MANAOS

	1907	1908	1909	1910	1911	1912	1913	1914	1915	1916
1. Yellow fever	170	117	61	206	278	172	111	..	..	..
2. Plague	..	..	..	..	..	..	..	..	..	..
3. Smallpox	38	6	1	33	10	..	36	..	..	..
4. Measles	1	1	..	16	3	1	1	..	..	57
5. Scarlet fever	..	..	..	..	..	..	..	..	..	..
6. Whooping cough	4	..	..	..	2	1	6	3	1	..
7. Diphtheria and croup	1	1	2	1	..	..	1	2	1	..
8. Grippe	5	6	11	21	5	6	7	6	3	6
9. Typhoid fever	4	16	12	10	5	10	2	2	1	1
10. Diarrhea	..	..	..	..	..	..	..	..	..	..
11. Cholera	..	..	..	..	..	..	..	..	..	..
12. Dysentery	33	32	78	48	47	31	18	7	4	23
13. Beriberi	63	119	83	149	135	80	61	20	12	4
14. Leprosy	1	2	1	5	4	1	3	8	8	7
15. Erysipelas	1	..	3	4	1	2	..	1	..	..
16. Other epidemic diseases	1	..	..	..	..	..	..	..	..	..
17. Malaria acute	208	266	341	436	549	412	297	276	213	296
17. Malaria chronic	122	210	136	157	162	151	119	103	86	67
18. Pulmonary tuberculosis	108	113	109	102	151	152	124	130	147	95
19. Tuberculous meningitis	1	..	..	..	..	..	2	2	..	..
20. Tuberculosis of other organs	4	16	3	26	3	11	2	8	8	8

21. Septicaemia (except puerperal)	4	8	5	15	19	9	13	11	14	9
22. Ankylostomiasis	12	19	11	19	20	18	16	18	23	17
23. Cancer and other malignant tumors	7	4	11	7	10	13	8	13	9	11
24. Other tumors	..	1	..	..	..	1	3	2	2	..
25. Other general diseases	11	17	13	17	16	14	4	..	..	..
26. Diseases of the nervous system	23	16	32	16	9	14	37	10	21	2
27. Diseases of the circulatory system	67	94	93	111	112	80	97	60	57	9
28. Alcoholism	3	3	2	..	4	9	7	7	5	6
29. Lead poisoning	..	..	..	..	1	..	..	..	1	1
30. Syphilis	5	12	5	3	7	3	4	10	5	5
31. Myasis	1	..	..	..	1	2	1	..	..	1
32. Diseases of the respiratory system	130	55	74	103	72	74	96	82	53	79
33. Diseases of the digestive system	126	200	165	210	151	167	218	219	212	218
34. Diseases of the urinary system	18	16	16	23	28	26	24	18	19	7
35. Diseases of the genital organs	1	2	1	2	1	1	..	..	..	..
36. Puerperal septicaemia	6	8	6	4	9	7	9	11	4	8
37. Other accidents of pregnancy	3	9	5	8	8	8	5	4	6	3
38. Diseases of the skin & subcutaneous tissues	3	2	1	..	..	7	1	..	1	1
39. Diseases of the organs of locomotion	..	..	1	1	2	..	..	1	..	..
40. Special diseases of infancy	64	244	205	266	310	226	109	67	55	46
41. Congenital debility and malformation	15	10	62	12	31	33	56	33	30	31
42. Senile debility	8	10	8	3	10	7	7	7	1	7
43. Deaths by violence (not suicides)	39	30	40	60	39	57	49	32	29	20
44. Suicides	3	6	5	2	3	7	1	2	1	..
45. Cause not specified	15	21	1	21	14	8	53	48	62	40
46. Still born	109	72	35	79	101	105	79	82	103	80

DEATH RATE

Year	Population (estimated)	Deaths	Death rate per 1000
1907	50,000	1438	28.7
1908	50,000	1764	38.5
1909	50,000	1638	32.7
1910	60,000	2196	36.6
1911	60,000	2333	39.0
1912	60,000	1921	32.0
1913	70,000 (?)	1687	24.1 (?)
1914	70,000 (?)	1305	18.6 (?)
1915	70,000 (?)	1197	17.1 (?)
1916	70,000 (?)	1165	16.6 (?)

Here it seems possible that the very low incidence of cancer may be partly explained by cases wrongly included under " Diseases of the Digestive System " and possibly cirrhosis of the liver also falls under this category. The apparent fall in death rate since 1913 is readily explained. It was influenced somewhat by the fall in deaths from yellow fever, but the great factor has been the decline in population. That this has diminished in the last four years thirty to forty per cent is a matter of common knowledge, the fall being coincident with the decline in importance of the rubber industry. Cutting down the given estimate of population one half would give what is probably nearly the correct figure of 33.3 instead of 16.6.

The rainfall as given is somewhat less than that of Pará, and the temperature is about the same as Pará.

IQUITOS

Iquitos is the third in size of the Amazon cities and is situated on the Amazon in Peru two hundred miles from the Brazilian border and twenty-three hundred miles from the mouth of the river. It has only recently attained any importance. Mar, who crossed the Andes from Truxillo in 1829, and came down the river, speaks

of it as a pueblo not surpassing in size and number of inhabitants those he had passed through in the mountains. Herndon, who passed through it in 1853, speaks of it as composed of about two hundred and fifty fishermen and inferior in importance to most of the Brazilian towns on the river. The city lies on a high bank about eighty feet above the level of the river at the time we were there, December 29 to January 3. It is a centre for the collection and export of rubber and since the decline in price of that commodity the population has decreased from 18,000 to 12,000. The river shore forms the most interesting and picturesque part of the city. Boats of all sorts lie moored to the bank and quite a population dwells upon them and may be seen in the daily work of bathing, washing clothes, and cooking. Among these boats are large rafts which have come down from the smaller rivers, making journeys often of several hundred miles. On the raft is a thatched house and accommodations for cattle and poultry, which are carried for food on the way or disposed of in the city. Both cargo and raft are sold, the latter for firewood, and the return journey is made in a steamer or in a canoe which is towed down. The bank is grown up with patches of magnificent calladiums, the leaves often four feet long and two broad, cannas and many flowering plants. The houses in places straggle down the bank, assuming picturesque but apparently unstable attitudes. The streets are either very badly paved or not at all, and the drainage is conducted in side ditches with pools at intervals. There is no general water supply, water being provided by wells, cisterns, and natural springs in or near the city, or pumped up from the river. There is but one very badly kept public square, with a few almond trees which with their pyramidal shape and tiers of horizontal

branches are always pleasing, but here more or less broken and unkempt. There are no tramways or pleasure vehicles; joy riding being served only by a narrow gauge railroad which though ordinarily used for freight only, on holidays runs, at long intervals, a train of tiny passenger cars a short distance into the country. The people as a whole look fairly well and have more pleasing faces than have the Brazilians. Many more Indians are seen, fewer negroes than lower down, and the admixture is rather with the Indian than with the negro.

FIG. 20. MILITARY HOSPITAL AT IQUITOS.

There is a hospital of forty beds situated about two miles from the centre of the city which though under the care of the army also serves as a municipal hospital (Fig. 20). There is a male and female ward and between them a small pavilion for administration. All parts of the hospital were clean and the patients seemed well cared for. The wards contained numerous cases of ulcers which were diagnosed as Leishmania. One of these was owned by an Irishman, fifty-seven years old, who had come from the Cordilleras, and had been fourteen months in the hospital. The physician in charge, Dr. Mantero, was very kind in showing us the wards and giving information. We used as interpreter one of the ubiquitous Barbados negroes. Dr. Mantero said

malaria was not common in Iquitos but there was much in the surrounding country. Occasional cases of dysentery, both the amoebic and bacillary type, came to the hospital and this disease was more common on the Napo river. Tuberculosis was fairly common, and hookworm the great scourge affecting eighty per cent of the population; twenty per cent of the cases were of the grave form of anaemia produced by this. Tropical ulcers were common and did well under local antiseptic treatment; the intravenous injections of antimony of which we had heard so much in Pará and Manaos were not used. It was also very evident that under the name of tropical ulcer all sorts of conditions, both the ordinary varicose ulcer and skin carcinoma, were included. On the way from the hospital we crossed a ravine where there are several springs, the water of which is used for washing, and forms a large part of the regular water supply of the city, into which it is carried in large jars. The washing was being done in pools below the springs. There were many children playing in the vicinity and a number of houses were above the springs which were low, the surface water draining into them. All of the children seen here were anaemic and evidently infected with hookworm. Dr. Mantero thought that the principal mode of extension of the hookworm infection was by drinking water contaminated with the embryos of the hookworm.

FIG. 21. TUBERCULAR LEPROSY. IQUITOS.

In the leper hospital, which is on the outskirts of the city, there were eight cases, of well marked and advanced tubercular leprosy (Fig. 21).

The appended health report of the city for 1916 is interesting but we should not care to say that it is reliable:

HEALTH REPORT OF THE CITY OF IQUITOS, PERU

1916

Deaths in 1916		285
Births in 1916		976

Causes of Death

*Not specified		130
Tuberculosis		30
Pulmonary	11	
Generalized	10	
Abdominal	1	
Larynx	2	
Pott's disease	2	
Other organs	4	
Anaemia	7	16
Intestinal parasites	9	
(Both probably refer to *ankylostomiasis*)		
Acute intestinal diseases		20
Diarrhea: children less than 2 years	9	
Diarrhea: children more than 2 years	5	
Dysentery	6	
Malaria		11
Measles ("serampion")		10
Acute respiratory infections		14
Broncho-pneumonia	10	
Lobar pneumonia	1	
Bronchitis	1	
Grippe	1	
Gangrene of lung	1	
Syphilis		2
Aneurysm		3
General paresis		1
Cancer		3
Female genital organs	2	
Other organs	1	
Tetanus		4
Cirrhosis		3

Accidents of pregnancy		1
Puerperal septicaemia		2
Congenital debility		4
Still born		2
Suicides		5
Poison	1	
Fire-arms	4	
Accidental drowning		4
Accidental burning		1
Yellow fever		1
Rheumatism		1
Asthma		1
Chorea		1

In looking over this report, which on its face is obviously imperfect, the first item showing the great excess of births over deaths is striking, when it is considered that the city has a declining population. The probable explanation is that deaths, particularly those of children, are not reported, and some confirmation is given to this by the small number of deaths due to infantile diseases. Another striking feature in the report is that not a single death is reported as due to cardiac and renal disease. In the non-specified deaths Dr. Ferradas, the port physician, and a man of intelligence, thought that fifty per cent of these were due to ankylostomiasis, which if true would make this the most common cause of death, and it is not improbable that some cardiac and renal cases were included under this category. Still we saw no such cases in the hospital and the physicians said they were very rare. We thought that there might be some relation between this and longevity and endeavored to ascertain something regarding the age at death by visiting the cemetery and getting the recorded ages from the stones, but the cemetery though well kept and interesting in the varieties of trees which had been planted, did not give such information. In most cases age was not given and the average of the sixty

ages which we found was 25.73 which if of any value did not bear out our hypothesis that life in Iquitos was of short duration. Of the sixty cases eight were more than sixty years and there was one of eighty and one of ninety-two. Another interesting feature in the report is that but three deaths from cancer are recorded. While the recorded death causes are usually those of obvious diseases, still cancer of the breast and epidermoid cancers, superficial tumors, etc., are sufficiently obvious. Here as elsewhere in the Amazon valley tumors of all sorts, both benign and malignant, appear to be relatively rare. We were told that malaria was rare and in the report but eleven deaths are set down as caused by it, and while in the city we saw very few mosquitoes. Why malaria is not common here is one of the many puzzling features of this disease we encountered. More favorable conditions for mosquito propagation could not be contrived, and infected individuals are constantly coming here from the rivers, both above and below. In death reports the tendency would be to attribute more rather than less cases to this cause.

Such a health report as this with all its obvious imperfections is better than none at all, for it represents a desire to do something, to make some contribution to knowledge and from such beginnings more perfect work will proceed.

Conditions on the Rio Negro

The Rio Negro, one of the main tributaries of the Amazon, carries into this the drainage of an enormous area provided with a great rainfall. This area comprises the northern Amazonas bordering on British Guiana, Venezuela, and Colombia, as well as nearly the entire western watershed of Colombia. It receives a

number of rivers, the largest of which are the Rio Branco, the Uaupes, and the Guainia. The lower four hundred miles of the river has much the character of a lake, the fall is very slight, the river is broad and there are great numbers of islands. Most of these islands are formed of (Fig. 22) igapó, that is, land ordinarily a few feet only above the surface and completely submerged during high water. The true banks of the river are

FIG. 22. THE LOWER RIO NEGRO. CLUSTERS OF JAVARY PALMS.

formed of terra firme, but igapó and varzea extend to a considerable distance along the smaller entering rivers. There is a great rise of the river during the wet season, more pronounced in the lower than in the upper part. San Isabel, five hundred miles from Manaos, is at the head of steam navigation and the river commencing some eighty miles below this changes its character, is no longer so wide, the islands are less numerous, the current more rapid, and the banks composed of granite. Many of the islands have a granite foundation and single projecting granite rocks are seen (Fig. 23). Above

San Isabel all these conditions are more pronounced and the river has the character of one coming from a high granite country. There are numerous and extensive sand bars due to the disintegration of the granite above which seems to be proceeding rapidly. The name of the river is appropriate to the color of the water which though perfectly clear, is a pale amber as seen in a glass, and the mass of water is jet black. At the time we were on the river, January to April, there was little

FIG. 23. THE RIO NEGRO. GRANITE FORMATION.

wind, an occasional squall or rainstorm, but usually the river had a glassy surface giving a perfect mirror. The ever present clouds of the day and the starlit sky at night reflected from the black surface were of wonderful beauty. The rainy season, with its period of high water, is from March to June, but there is usually a temporary rise in December. The rise is very great, the entire lower part of the river and the islands being flooded. The entire country on both sides of the river is heavily forested, there being merely small clearings for pastures about the villages and the sitios where the large rubber merchants live.

The population along the river is extremely scarce. Senhor Netto, an intelligent gentleman, the governor of

the district of Barcellos, estimates the population from Manaos to the Venezuelan border, a distance of seven hundred miles, at not more than five thousand. There is no census and this estimate is based on the amount of rubber which the country produces. The population is along the rivers, the great stretches of forest between being uninhabited, save by the few wandering forest Indians. The country has also never been explored, the heights, the character, and the relations of the several mountain ranges have never been determined.

There seems little doubt that the region was formerly more thickly settled than at present, as shown by the ruined churches in the villages and by the traditions of population. Before the days of rubber production it was an agricultural region, quantities of coffee, corn, cacao, rice, vanilla, anatto, and indigo being produced. Senhor Netto attributes the decline in population to several factors, such as the introduction of disease by the traders, the development of the rubber industry which caused the people to neglect agriculture, and with all this the extension of alcoholism. The climate is good, the nights cool, the insect pests, save in certain places, are not very bad, and the soil is fertile.

The Lower River

From the view point of disease there is a sharp separation between the lower and upper river at San Isabel, the head of steam navigation. From Manaos to San Isabel and on the return we made numerous stops, sometimes for a few hours only, at others for several days, and there was opportunity for study of the people. There are many Indians and a large admixture of Indian blood, comparatively few negroes and mulattoes. The pure whites are of various nationalities, but chiefly

Portuguese. The people seen presented the indications of ill health; the nutrition was poor, there was evident anaemia and lack of energy.

Malaria in the Cities

In Pará, Manaos, and Iquitos there are doctors, hospitals, and more or less efficient health departments. Hospital and city officials extended us every courtesy making it possible to collect considerable data regarding malaria and other endemic tropical diseases during our brief visits. Annual health reports are published in all three cities, and in Manaos there are monthly reports extending back for a period of ten years.

According to these reports malaria is not only the commonest disease of the country, but is the direct cause of much the largest number of deaths. The figures are quite astounding. For example, in Manaos, out of a total of 15,500 deaths in the last ten years, 4250, or 28 per cent are attributed to malaria. Pulmonary tuberculosis, the next most common cause, was responsible for 1136 deaths, or 7 per cent of the total. It may be explained that the tuberculosis rate is almost as high as in New York, where this disease stands first or second among the causes of death. According to these statistics then, malaria causes four times as many deaths as any other single disease, a number relatively five times as great as that of any one disease in New York. The death rate in Manaos from all causes, cannot be accurately stated since the population has varied so much in the last ten years. It is probably high, that is, 35 per 1000 or more. That of Pará is somewhat lower.

Are these figures regarding the mortality from malaria reasonably accurate? Our investigations, though brief and incomplete, would indicate that they are not and

we are inclined to think that malaria does not cause half as many deaths as are attributed to it. In the first place, diagnosis is practically never confirmed by microscopic examination of the blood. In the eight hospitals visited, we saw only a single microscope. This was in a small sanitarium in Manaos, owned by an English doctor whose practice is limited to the English colony. Secondly, we got the impression that, as a general rule, correct diagnoses were made only on cases where the nature of the disease was obvious, such as leprosy or dysentery, and where there was doubt, malaria was the diagnosis most often set down. It is the scrap pile, as it were. Thirdly, during our three stops at Manaos, where we were altogether nearly three weeks, we made a number of visits to the 300-bed municipal hospital, but we never saw a single case of severe or fatal malaria. One case diagnosed as such was autopsied by us and found to be pneumococcus meningitis.

We did see, however, any number of people in the hospital with enlarged, hard spleens, who gave a history of fever. Most of these cases had been admitted for other troubles, such as dysentery and tropical ulcer. In one ward, containing twenty ulcer cases, there were ten with easily palpable spleens. There can be little doubt that malaria is very prevalent in the cities and towns, as well as in the country, but our observations would indicate that the number of deaths directly attributable to it is much lower than the statistics show.

In Monte Alegre, Santarem, and Obidos, towns on the lower Amazon, conditions as regards malaria are about the same as in Pará and Manaos. At least one doctor or pharmacist was found in each place. The doctors and others with whom we talked told us that chills and fever were common toward the end of the rainy season

especially, but that the infection responded readily to quinine, which was often administered subcutaneously. The people looked healthy and our blood specimens were negative except in three cases. We saw no big abdomens or enlarged spleens such as were a common sight on the Rio Negro. We saw at Santarem three cases of fever, which the attending doctor diagnosed as malaria. The patients were being treated with quinine without effect, and the cases looked to us like typical typhoid fever. The doctor, however, insisted that typhoid fever did not exist in that section.

Malaria on the Rio Negro

Our stay of several months on the Rio Negro afforded a better opportunity for the study of medical conditions than was possible in the cities, where our visits lasted only a week or two at the most. There are no doctors on the river. In fact the entire stretch of country between Manaos and Bogota, a distance of more than a thousand miles, is without medical aid of any kind. Medicines, except the herb and plant extracts of the Indians, are obtained only through the slow and infrequent communication with Manaos.

At every settlement sick people were examined and questioned, blood smears taken and facts regarding the diseases of the section obtained from the more intelligent members of the community. The number examined at different places and the results of blood and spleen examinations are indicated in Table I. On the lower river, that is, that part between Manaos and San Isabel, conditions were everywhere very much the same, and very deplorable. In some settlements, such as, for example, Carvoeiro and Moura, near the mouth of the Rio Branco, scarcely a single healthy person could

be found. Practically all of the children and many of the adults had prominent abdomens and big, hard, easily palpable spleens which in some instances almost filled the abdomen, and all were more or less anaemic and weak. No one was able to do a real good day's work. A history of fever could be obtained from many, but there were quite a number of children with big spleens, who according to their parents had never suffered from chills or fever. Our limited knowledge of the language spoken made it difficult to get accurate information. (Portuguese is the language of the country, but many of the Indians know only their native tongue, — Tupi-guarani or Lingo-geral, as it is called.) Cases showing acute symptoms were rarely encountered and in the blood of these few, parasites were easily demonstrated. Blood smears of the majority of the children, however, with big, hard spleens and moderate anaemia were negative, although a prolonged search through several smears sometimes was rewarded by the discovery of a single organism, usually of the aestivo-autumnal variety.

That the weakness and anaemia and large spleens were in all cases the result of chronic malarial infection is doubtful. Examination of the faeces of several very anaęmic children showed numerous hookworm ova. The presence of an eosinophilia in at least 80 per cent of the people is also an indication of wide-spread hookworm infection. In many instances, the eosinophiles were more than 20 per cent. (See table.) The table shows also a high mononuclear count, which may be referable to the chronic malaria.

On the upper portion of the river, that is, between San Isabel and San Gabriel, the people looked much healthier. Practically no big spleens were found and a

history of malaria was rarely obtained. Blood smears were negative in all cases.

It may be of interest to compare the manifestations of malaria such as we found in the Amazon region with those observed in other malarious countries. Koch in West Africa and New Guinea, James, Stevens, and Christophers in India, Panse in East Africa, Plehn in the Kamerun, Craig in the Philippines, and Daniels in Guiana have given good descriptions of malaria in the respective countries. It is evident from a review of their observations, that endemic malaria may manifest itself differently in different countries and peoples. At least three general types of infection may be recognized:

1. An infection characterized by the presence of numerous parasites in the blood, especially in children under ten years, with little or no disturbance in health. The infection disappears without treatment as the child grows older. There is no febrile reaction and no evident anaemia or weakness. Koch describes the condition in West Africa and New Guinea, where he found organisms in the blood of every child under two years; in 48 per cent of those between two and five years and 23 per cent of those between five and ten years; none in those over ten years. Craig gives similar figures for native Philippine children; he also found a large percentage of " healthy " adults, harboring parasites in large numbers. The condition is also described by James in India, Panse in East Africa, and Plehn in the Kamerun. Plehn, who saw many of these " carriers " among adults, says they sometimes, but rarely, develop chills and fever. When they do it is exceptional to see more than one chill, even when no quinine is administered. All of the authors refer to the state as one of partial immunity, probably inherited. It may be thought of as a sort of

mutual adaptation of host and parasite, or symbiosis, such as is seen in the rat trypanosome infections, where the animal remains healthy even though his blood be teeming with parasites. Not a single example of this type of infection was found by us in Brazil.

2. A chronic infection characterized by moderate anaemia, weakness, and splenic enlargement which is sometimes extreme, and by an absence or great scarcity of organisms in the circulating blood. This condition corresponds probably to the so-called " malarial cachexia " of many writers. In certain parts of India, this type of infection is very common. Koch does not mention it in South Africa or New Guinea, and it was not seen by Craig in the Philippine natives. In the Amazon region it is the type of infection which predominates; in fact, at least 90 per cent of the cases we saw could be placed in this group. The splenic enlargement is not a constant feature according to Daniels, who says that in Guiana, where malaria is extremely prevalent, malarial spleens of great size are rare. His observations are based largely on autopsy findings. He thinks there may be some other factor than malaria, which is responsible for the huge spleens sometimes seen in malarious districts. On the Rio Negro, as we have pointed out, extreme splenic enlargement was the most striking feature of the cases.

3. The ordinary type of infection as we see it in susceptible temperate-zone people who visit the tropics is periodic attacks of chills and fever, with progressive anaemia, etc. With this manifestation of malaria, everyone is, of course, familiar. In the Philippines an outbreak of chills and fever in a camp of American soldiers led Craig to look for the source of infection among the natives living close by. Although none

were having chills or fever or looked chronically ill, Craig found any number of " carriers " among them, showing that the striking difference in reaction in the Americans and natives was due to a difference in host and not in the type of malarial organism concerned. In our expedition, the single member of the party who contracted malaria, developed typical chills and fever on alternate days; while on the lower Rio Negro, where he got the infection (Fig. 24), chills and fever are rarely seen, nearly all of the cases exhibiting the chronic cachetic state.

Summary

1. Malaria in chronic form is extremely prevalent in the Amazon Valley, both in the cities and in the sparsely settled districts along the rivers. It is the cause of much poverty and misery, and is one of the chief causes of the country's lack of development.

2. Examples of severe acute or malignant malaria were not observed, but we were told that on certain rivers, especially the Madeira, not visited by us, fatal attacks were common. Statistics indicating high mortality of malaria in cities are of doubtful accuracy.

3. A relatively small number of cases examined showed organisms in the circulating blood, eleven out of one hundred and fifty-three or 7.2 per cent. Had we taken blood smears from the entire population, instead of selecting, in many places, those who looked ill or were complaining, the percentage of positives would have been still smaller. On the other hand, a more exhaustive search through several smears from each individual would probably have increased the number of positives. Indeed, a second examination of twenty slides from cases in which there was a definite history of malaria

FIG. 24. AESTIVO-AUTUMNAL PARASITE. SMEAR FROM BLOOD OF MEMBER OF EXPEDITION WHO CONTRACTED MALARIA ON THE LOWER RIO NEGRO.

TABLE I. BLOOD AND SPLEEN EXAMINATIONS

	Blood examination	Positive	Negative	Spleen examination	Positive	Negative	Total number of cases examined
Monte Alegre, Santarem, and Obidos on Lower Amazon..	32	3	29	8	..	8	40
Manaos.....	3	..	3	20	10	10	20
Barcellos, Lower Rio Negro..	25	2	23	20	14	6	25
Carvoeiro, Lower Rio Negro.	8	..	8	7	7	..	8
Castanha, Lower Rio Negro .	9	..	9	9	..	9	9
Vista Alegre,Lower Rio Negro	7	..	7	6	5	1	7
San Isabel, Lower Rio Negro	12	3	9	16	13	3	16
Javari, Moura, Providentia, and other places on Lower Rio Negro.....	37	3	34	30	16	14	40
San Gabriel, Upper Rio Negro	17	..	17	14	1	13	17
San José and other places on Upper Rio Negro.....	3	..	..	23	..	23	23
	153	11	139	153	66	87	204

Blood, positive (" Parasite rate ")..... 7.2 %
Spleen, positive (" Spleen rate ")..... 43.8 %

TABLE II. DIFFERENTIAL BLOOD COUNTS

Place	Neutrophiles	Mononuclears	Eosinophiles
Barcellos, average of 20 cases.....	41.5	48.5	10
Lower Rio Negro, average of 20 cases	37.5	46.5	16
Lower Rio Negro, average of 35 cases	39.0	46.0	15
San Isabel, average of 10 cases	37.0	50.0	13
San Gabriel, average of 15 cases.....	39.0	40.0	21

	Highest Count	Lowest Count
Neutrophiles.....	68	8
Mononuclears.....	75	20
Eosinophiles.....	44	1

Splenic Enlargement

In eighty-eight cases the spleen was examined and found enlarged in fifty-five. There were various degrees of this enlargement, but no case was included under this in which the spleen was not distinctly palpable. There did not seem to be any definite relation between the large spleens and malaria. In the four tertian cases

Fig. 25. Children with large spleens. Lower Rio Negro.

the spleen was not palpable, in the four cases of aestivo-autumnal it was large in two and just palpable in two. Some of the spleens examined were huge, larger than any leucaemic cases we have seen, the dullness extending from the mammary line well into the pelvis and considerably to the right of the umbilicus. The spleen seemed rather flatter than in leucaemia; in one case the edge could be distinctly grasped through the thin abdominal walls and it did not seem to be more than 3 cm.

in thickness (Fig. 25). There was no difficulty in the determination of the condition, it being necessary in most cases merely to put the hand on the splenic region and in some individuals when standing there was a distinct protuberance of the left side of the abdomen. It was also necessary merely to question the individuals,

FIG. 26. ENLARGED SPLEENS IN MEMBERS OF THE SAME FAMILY. LOWER RIO NEGRO.

for all except the children were well aware of the condition. The spleen as a rule was of intense hardness and rarely tender. It was found both in children and in adults (Fig. 26), the youngest case being four years of age, but there was not opportunity for the examination of very young children.

All of the cases in which these spleens were found showed a greater or less degree of ill health though most

of them pursued their ordinary vocations. They frequently complained of constipation, which we thought was possibly attributable to pressure upon the colon. There was also more or less anaemia, but there was nothing in the blood examination to throw light on the condition. All gave a history of malaria (paludismo) at some time in the recent or remote past, but for that matter so does everyone in the country. What is the relation of these huge spleens to malaria, if there be any, we do not know. There was no opportunity for the study of the condition by post mortem examination. As we have known malaria, one of us having had an extensive experience with the disease in Maryland, such spleens are not found. The ordinary condition is a hard pigmented organ, rarely exceeding four hundred grams in weight, and from the apparent size of the spleen in these Rio Negro cases it must frequently have exceeded two thousand grams. Thomas, however, at Manaos, who has seen many of these cases of splenomegaly from the rivers, regards them as malarial and has found often only after the examination of a number of slides, either single organisms or pigment in the leucocytes. He treats the cases with enormous doses of quinine hypodermically administered and he thinks with benefit. The same uncertainty is seen in the literature. In the paper of Daniels, "Enlarged Spleens and Malaria" (Thompson, *Yates Laboratory Reports*, 1901) based on examinations in British Guiana, he says that splenic enlargement is rare though the country is very malarious. His report is valuable as it is based on autopsy records and weights of the spleens are given. Pigmentation of the spleen, which was found in a high percentage of the cases, bore no relation to the size. He refers to observations in Central Africa, where he saw much malaria

and there enlarged spleen was common in children (50 per cent of cases) but he found no enlargement in adults. He suggests that some other factor than malaria is concerned in the splenomegaly of malarious districts. We append the valuable table of Daniels.

WEIGHT OF SPLEENS AT AUTOPSY

	East Indies		N. N. of B. G.[1]		Aboriginals of Brit. G.		Immigrant negroes		Europeans in Brit. G.	
	N-P[2]	P[3]	N-P	P	N-P	P	N-P	P	N-P	P
Number of cases....	345	80	171	57	9	4	65	63	12	7
	%	%	%	%	%	%	%	%	%	%
Under 150 gr.	4.9	11.2	33.9	35.2	..	..	46.1	31.9	25.5	..
150–300 gr.	18.5	32.5	47.3	42.6	22.2	25	32.3	41.2	41.6	..
300–450 gr.	24.0	23.7	9.9	14.8	11.1	..	6.1	14.2	8.3	57.1
450–600 gr.	15.6	20.0	6.4	5.5	22.2	50	12.2	6.3	16.6	14.2
600–750 gr.	12.7	2.5	1.2	..	11.1	..	..	4.7	..	14.2
750–900 gr.	9.8	2.5	.58	..	..	..	..	..	..	14.2
900–1200 gr.	5.2	5.0	.58	..	..	..	..	1.6	..	..
1200–1500 gr.	5.5	..	..	..	..	25	1.5	..	..	..
1500–1800 gr.	2.0	..	..	..	..	..	..	..	..	..
Over 1800 gr.	2.0	2.5	..	..	11.1	..	..	..	..	..

[1] Native negroes of British Guiana. [2] Non-pigmented. [3] Pigmented.
Pigmented spleens = malarial spleens.

Craig, *The Malarial Fevers*, 1909, says enlargement during acute attacks is not constant; in most cases the spleen is not palpable. But where the condition is chronic and especially if there have been many relapses, the splenic enlargement is generally noticeable; the organ is palpable and may extend to the umbilicus. In aestivo-autumnal infections a palpable spleen is more often found, and in old infections the spleen is hard and presents a well defined border. Under malarial cachexia he says: " Enlargement of the spleen is a common condition but not an invariable one. I have observed many cases of chronic malarial infection in

which the spleen was but little if any enlarged. In old cases the organ may be enormously enlarged, reaching as low as the crest of the ilium, but as a rule it does not extend more than 4–8 cm. below the borders of the ribs. It is firm but not painful on palpation." Deaderick, *A Practical Study of Malaria*, 1909, says: "The spleen may be of normal proportions in mild cases but is usually enlarged, sometimes enormously so, passing the median line of the abdomen and the iliac crest. In the malarial cachexia the most pronounced phenomena are the anaemia and the enlarged spleen. The spleen often extends to the umbilicus and to the crest of the ilium, sometimes beyond. It is hard, the anterior border presents a sharp edge and pain and tenderness on pressure are not always felt." He gives a number of photographs of men and boys showing spleens quite comparable to those we saw.

Stephens and Christophers, "The Relation between the Large Spleen and Parasitic Infection," *Reports to the Malarial Committee, Royal Society of London*, 1902, reach these conclusions: (1) "A high endemic index (as determined by blood examinations of children) may exist without any appreciative spleen rate (Africa). (2) A high spleen rate may exist in adults without a corresponding parasite infection. (3) In India (Bengal) among children a high spleen rate is a fair index of the parasitic infection. (4) The spleen rate, unlike the parasitic rate, increases up to a certain age limit and may be considerable when the parasite rate is nil." They examined eighty cases in the native hospitals of Calcutta with enlargement of the spleen varying from two or three fingers breadth below the ribs to that of a spleen filling the whole left side of the abdomen and reaching to the pubes. In none of these cases did they

find parasites or pigmented leucocytes or any mononuclear increase such as they showed in previous reports to be characteristic of recent infection. In six post mortem examinations on such cases no parasites were found in either spleen or bone marrow. They quote from Plehn, *Die Kamerun Küste*, who says that in the majority of the cases examined by him on the Kamerun coast the spleen is not larger than in cases of typhoid seen in Germany, and may be much smaller than this. Annett, Dutton, and Elliot, "Report of Malarial Expedition to Nigeria" (Thompson, *Yates Laboratory Reports*, 1902) do not mention splenic enlargement as occurring in the natives. Darling, in his studies of the diseases at the Ancon Hospital in Panama, has seen many of these huge spleens, they being known there as the Colombian spleen, and at autopsies he made smears from the spleens. In three cases he found in the greatly enlarged spleen and in the liver numbers of organisms which he described under the name Histoplasma Capsulatum (*Jour. Exper. Med.*, vol. xi, 1909) and which he thinks differ from the Leishmania of Kala Azar. Two of the cases were Martinique negroes and one a Chinaman who had lived fifteen years on the Isthmus. Darling regards as the main difference between his organism and that of Kala Azar, the absence of the second nucleus. It should be remarked that the presence of this, both in smears and sections of organs may easily be obscured and a comparison of Darling's photographs with sections from typical cases of Kala Azar leaves little doubt in the mind that Darling's cases were really Kala Azar. In the other cases examined Darling found no organisms. Ross, who visited the Isthmus in 1904 and studied the cases of enlarged spleen with reference to the symptom group of Kala

Azar, did not find this. In addition to the cases of enlarged spleens which we found on the Rio Negro, we saw great numbers of similar cases in the hospitals of Manaos and Pará, particularly in the latter. They came from the upper waters of the rivers and were complicated both by ulcers and malaria, but there seemed no interrelation. Although from Darling's report it seems more than probable that certain of these cases may be Kala Azar, this cannot be held to be the common cause. We think that the most of these cases belong to that very obscure condition known as tropical splenomegaly.

The Upper Rio Negro

Very different were the conditions found along the upper river about San Isabel. As we have said, the current is here more rapid, with the exception of certain stretches where the conditions of the lower river are approached, and the banks, islands, and river bed are granite. There is even less population than below, and little pretense to the formation of villages, there being as a rule merely the more or less extensive sitios of the rubber merchants with a few houses of dependents. The population in these places varies depending upon the season of rubber gathering. The extent of country owned or rather controlled by each of the rubber merchants and the number of persons employed in rubber gathering varies. The gatherers, *seringueros*, are chiefly the Indians of the region, who seem to go with the land, and who when weaned from their forest life become practically slaves and totally dependent upon the trader. Rum, which they soon learn to regard as a primal necessity, is the active agent in their reduction to such a condition, but civilization offers other baits as

well, such as small sewing machines, music boxes, etc. Once when travelling on the river with a merchant, a seringuero of wretched appearance, pale and anaemic, presented a list of articles which he wished advanced, such as sugar, coffee, mandioca, etc., but as the poor wretch was already in arrears he was given merely the necessities of life, which consisted of a gallon of rum and

FIG. 26A. CHILDREN AT SAN GABRIEL. NO SPLENIC ENLARGEMENT.

a package of matches. As many as three thousand gatherers may be attached to a single station.

On this upper river there were seventeen examinations of blood, none of them positive. There was little complaint of malaria, although we were told that cases occurred at the end of the rainy season. Mosquitoes we found not at all, although we slept for the most part in native houses, nor in the numerous examinations of the people was there evidence of these having been bitten. The contrast between the populations was striking; on the upper river the people were well nourished and seemingly healthy. The single case of real illness was

that of a merchant whose business in collecting rubber led him to take frequent trips below San Isabel and up various rivers. He gave a history of malarial attacks, but the principal trouble seemed cirrhosis of the liver. In thirty-eight cases the spleen was examined and found to be slightly enlarged in one. This was in a child in San Gabriel and was associated with slight enlargement of the liver and slight ascites with no history of malaria.

The very common condition of enlarged abdomen in the children was very evident and seemed to be due to gaseous distension (Fig. 26a). In this form of distension the thorax is bell shaped, greatly dilated below, due to the thrusting upwards of the abdominal contents, and the liver dullness is not so perceptible as in the normal.

Mosquitoes

It seems to us extraordinary that two regions on the same river and presenting such similar physical characteristics should so differ in health as the region below and that above San Isabel. It is true that the river below San Isabel is more sluggish with great lake-like expansions often twenty miles or more wide with numerous low islands, but above San Isabel there are many such places and the life of the people in the two regions is practically the same. There would seem to be every possible opportunity for the breeding of mosquitoes and the extension of malaria in the two places. There is water in pools formed as the river sinks, water collects from rains in rock depressions, and the irregularities of epiphytic plants holds it; that mosquitoes can breed in such places was shown by our finding numerous embryos in the pot holes in the granite at San Gabriel where we never saw an adult mosquito and where we found no malaria.

The ascent of the Rio Negro to San Isabel was made on a river steamer, we being the only passengers, and the steamer had been completely cleaned for our use. On this we slept without nets, ate on deck and sat there at night, and not a mosquito was seen. On the return from San Isabel on the launch a few mosquitoes were found and one of the party contracted malaria. One of the party returned on the regular river steamer from San Isabel and found very different conditions. This steamer, a larger boat than that on which we ascended, was of shallow draft and propelled by a stern wheel. There were two decks, the lower occupied by the machinery, the crew and the galley, together with freight and the animals carried along to be slaughtered for food. The officers and passengers occupied cabins which ran in a double row in the middle of the upper deck and aft of these the deck was open, giving a space for eating and sitting. The officers and most of the passengers slept in hammocks slung from supports on the upper deck and were not troubled with mosquitoes. The cabins, however, were so filled with them that sleep was impossible. They hid in dark corners and beneath the beds and could not be driven out. They were exclusively nocturnal and one could sleep in the cabin during the day without being bitten. The mosquitoes are small, dark in color, and their bites were thickly placed on exposed surfaces, produced little swelling and small areas of hyperaemia and hemorrhage. A well bitten foot and ankle bone has some resemblance to a severe typhus rash.

After a short stay in Manaos the same steamer was taken for a trip up the Autaz river, which took several days. Here the same conditions were found. The cabins swarmed with mosquitoes but there was little

annoyance when sleeping on deck in the open. The beginning of the high water was seen here and large areas of land were flooded.

No blood examinations were made but some of the people at landings said they had malaria and the population looked much like that on the lower Rio Negro. Two members of the crew, whose duties involved night work in their cabins, had chronic malaria and in one there was an acute exacerbation.

The conditions on the upper and lower Rio Negro being so similar, with the exception of the steam transportation on the lower river, it occurred to us after experience on the river steamers that this might have some influence on the distribution of disease. The boat makes many stops for wood and at the depots of freight collection and distribution. Nothing goes on with rapidity; the stops are long, the boat often remaining all night alongside the bank and several days are occupied at San Isabel. The arrival of the boat is an event, the inhabitants come on board and sit around resting, conversing, and enjoying the alcoholic cheer which the boat provides. The steamer gradually collects mosquitoes; a few come on board at Manaos and other places and all stay, finding undisturbed abodes in the cabins. Probably every passenger who comes on board, particularly if the night be passed in a cabin, and this is generally the case with the women, becomes infected or if so receives a fresh dose. The same is true but to a less extent with the visitors. Whether mosquitoes breed on the boat is uncertain. The water is taken from the river off the bow of the steamer and pumped into closed iron tanks on the deck roof. The lower deck is usually wet and in the confused mass of machinery, animals, cargo, and crew it would easily be possible for

small pools to form in out of the way places and serve for breeding, but such were not seen. The mosquitoes find abundant food in the humans, in the carcasses of the slaughtered cattle which are hung on the upper deck until used, and in the fruit which is carried. At the landing places the disease may be still further disseminated by the freighting canoes and launches which gather to meet the steamer. The prevalence of the disease on the lower river is also favored by the greater population and its collection in villages.

Diseases of the Indians

As we have observed the Indians in the hospitals in the Amazonian cities and about the villages on the Rio Negro, there does not seem to be any difference in diseases as compared with the whites. Concerning the diseases of the remote forest Indians, we know practically nothing. There have been but few explorers among them, and these have generally been more interested in their own ills than in those of the Indians; usually being devoid of medical training, the descriptions of diseases which they have given are of little value. The matter is of great importance, particularly in regard to malaria, for there are Indian tribes in the interior who have never come in contact with whites. Rice, whose exploration of the Uaupes was one of the most carefully conducted expeditions in Brazil, has given some account of the diseases of the forest Indians. (Rice, "River Uaupes," *Roy. Geog. Soc. Jour.*, 35, 1910). He says, regarding the Uaupes Indians, " They are curiously free from the most dreaded diseases of civilization, such as cancer, syphilis, and appendicitis. Fever due to malarial infection or simulating such is common, as are large spleens and livers. In the territory of the upper

river mosquitoes abound, and rest at night is impossible without nets. On the lower river they are absent for the most part, and infection due to malarial parasites must be transmitted by a host or means other than the anopheles. One case I saw of possible leprosy, and sporadic cases of beriberi are frequent. They are very susceptible to and dread influenza or deflux or catarrho, as it is variously termed. Eye diseases are extremely common, especially conjunctivitis. Infant mortality is high on account of intestinal diseases of protozoan or helminthic origin. Both carate or pinta and eczematous conditions are common. Bronchitis is frequent, due to the Indians' heedless exposure. Rheumatism is noticeably absent and so is tuberculosis, though with the growth of the rubber industry and the increased invasion of the white man, with consequent hybridization will come his two aborigine annihilators, syphilis and tuberculosis."

In a later exploration, in which he went from Bogota to San Martin and thence through the Northwest Amazon basin along the Inirida and Icana rivers to the Rio Negro, he speaks at more length concerning the diseases encountered. San Martin, inhabited by a mixed race of Indian and white, is a centre for the rubber of the district and diseases contracted along the upper waters of the rivers are brought there. He found malarial parasites in two hundred and fifty examinations of the blood of adults and children. Cariti or pinta was also very common. At San José, on the Guaviare, he found fevers and ulcers were common, and also a peculiar and painful disease of the toes, locally called sabañones. This begins with intense itching, especially between the toes, and a slight colorless exudate of foul odor. The skin turns white, sloughs off, acute inflammation ensues, and

the underlying tissue becomes pulpy. Any attempt to move the foot or even stand on it is productive of a most intense and unbearable pain. At Calamar he found the majority of the people ill, and he himself acquired a tropical ulcer, the cicatrix of which is shown (Fig. 31). On the Papunaua, a black water stream by which he passed from the Inirida to the Icana river, he found much disease among the Indians and the blood invariably showed tertian malarial organisms. The Icana would seem to be a much healthier stream than the Inirida and he makes no mention of diseases encountered here. It is interesting that he found malaria in the maloccas of tribes which had no outside contact, but the possibility of carriers could not well be excluded. He says nothing here in regard to splenic enlargement.

Chandless ("Exploration of the Purus," *Roy. Geog. Soc. Jour.*, 36, 1866) speaks of the great seasonal variation in health along this river. At the period of his exploration it was healthy, but eight years previously it was very unhealthy. He mentions a form of skin disease as common among the Indians, but gives no description of it. He says that Indians of other tribes have caught it and one white man, but it is not communicated by ordinary contact.

Whiffin (*The Northwest Amazon*, 1908) has made a careful study of the remote Indians, and naturally this embraces something of their diseases and medical practices. These Indians are cowards in sickness, believing it is due not to natural causes, but to charms and poisonings. Poisoning is common. Should an infectious disease appear, those attacked are abandoned. Malarial fevers are common, chest diseases rare, and respiratory diseases unknown. There is also no venereal disease. Lice are universal; ring-worm and intestinal parasites

are very common troubles, and chiggoes, always found in the houses, are a great pest. Regions have been devastated by smallpox, which was introduced by the rubber gatherers. Beriberi does not attack Indians, but pinta is not uncommon. Small families are the rule, children are not born frequently, two and a half years being the average between births, and the infant mortality is high. Twin births and congenital deformities are said to be unknown. These would be regarded as disgraceful, as simulating conditions which may be found in animals, and their absence may be due to the habit of washing the child immediately after birth, in the river, giving facility for losing an undesirable family connection.

Fawcett (" Explorations in Bolivia," *Roy. Geog. Soc. Jour.*, 35, 1910) found many interesting conditions in the country travelled, but says little about the diseases of the Indians. Espundia, an ulcerous sore difficult to heal and said to be due to the scratching of insect bites, was frequently encountered. The virus of this may be carried to the nose, causing sloughing of the cartilage. He also mentions the great variation in the sickness along the rivers in different years.

It is not impossible that there are preserved somewhere in the reports from the old Jesuit missions, which were scattered everywhere through the country, interesting and accurate descriptions of the Indians before the trader came into contact with them. The great explorers of the preceding century, Humboldt, Spix, and Martius, Wallace, Spruce, and Bates, have little or nothing on the subject of Indian diseases.[1] The conditions shown in the very meagre information we have are

[1] Martius, however, has given a very graphic description of the ravages of smallpox which he encountered on the Peruvian border.

about what we might expect. We should expect the incidence of malaria, especially in the latent and chronic forms, to be high, for the life of the Indians would favor it. The common house or malocca certainly offers ideal conditions, in facilities for harboring anopheles and there must be sufficient intercourse to give some of these a chance for infection.

Although reliable statistics are absent, there seems no doubt of a great diminution in the numbers of the Indian

FIG. 27. PARALYTIC FORM OF BERIBERI. IQUITOS.

population. There have been many factors in the diminution, but disease, particularly smallpox, has probably been the most important. To the factor of disease must be added inter-tribal wars, which were encouraged by the whites with the view of procuring slaves from the victors. The commercial exploitation at the present time, which increases alcoholism, breaks up the family life, and by increasing intercourse gives greater opportunity for the extension of infection, plays an important part in extermination. The Indians are without protection, practically at the mercy of a commercial people in whom the traditions of the exploitation of weaker peoples are firmly fixed. It would seem that man can always be trusted to kill the goose which lays the golden egg.

Leprosy

This is undoubtedly a wide-spread disease in the region, but how extensive there is no means of knowing. There are leper asylums attached to the cities and the principal towns, but there is no pretense to strict segregation. The cases we saw were of the ordinary tubercular and mutilating forms.

Beriberi

But one case of this (Fig. 27) a well marked paralytic form, was seen in the hospital at Iquitos. If this is a disease dependent upon food conditions the variety of food and the large use of fruit would seem not to favor it.

Yaws and other Forms of Skin Diseases

We saw no cases which were diagnosed as yaws and no cases which we recognized as this, but it might readily have been overlooked. Pian was not uncommon both in the hospital cases and along the rivers. There were a number of cases of skin disease, the diagnosis of which we could not determine.

Filariasis

In spite of the frequency of elephantiasis in Rio and the southern states of Brazil we saw in the Amazonas no cases either in the hospitals or among the people. We do not know whether there have been any systematic blood examinations to determine the absence of filariasis.

Other Diseases

At San Isabel we saw one typical case of acromegaly in a mulatto.

Ulcers

One of the most common conditions found in the hospitals of Pará, Manaos, and Iquitos, were ulcers, usually on the lower extremities and varying in extent and character. The ulcer patients form a large percentage of the hospital cases and generally come from the head waters of the rivers, most of those in Manaos from the Madeira. The subjects were usually badly nourished, anaemic, and had in addition malaria, and the huge spleens common to these regions. The spleens were particularly noticeable in the ulcer ward in Pará.

These ulcers have of late acquired a greater interest, due to the discovery in them of Leishmania, which places them in the category of the Button of the Orient. There is an extensive literature on the subject, most of which is contained in the Bulletins of the French Society of Tropical Medicine. The specific character of certain of these ulcers and the organisms associated with them were first noticed among the railroad workmen in Bauru, a town in the western part of San Paulo, the most southerly state of Brazil. Lindenberg (*Bull. de la soc. de path. exot.*, vol. ii, 1909) describes the ulcers as occurring chiefly on parts of the body which are uncovered. The ulcers are round or oval, sharply cut, with projected edges of a deep violet color, the base covered with deep vascular vegetations or with an adherent crust. Sections of the old ulcers showed nothing, but in one case in which there were several small ulcers 1.5 cm. in diameter and of one month duration, the sections showed the organisms first described by Wright, and in scrapings from other ulcers the same organisms were found. In 1895 Moreira described similar ulcers in Bahai, but did not recognize the parasite. Lindenberg's

results were confirmed in a following article by Carini and Paranhos, who think the disease follows the prick of an insect and appears first as a papule which later develops into an ulcer and becomes covered with a thick crust. Carini and Splendore in the same journal, 1911 and 1912, describe ulcers on the mucous membrane of the nose and hard palate, which follow the ulcers of the skin. In Carini's case the surface of the palate was ulcerated, the ulcer covered with irregular, prominent, firm granulations. There were also erosions covered with an adherent yellow exudate. The uvula was destroyed, and its place taken by a granulating surface. On the inner surface of the left nostril there was an oedematous swelling covered by a thick crust which almost occluded the nostril. Various travellers in Peru have spoken of similar ulcers of the mouth and nose, known there under the name of Espundia, and Escomel (*Bull. de la soc. de path. exot.*, 1911) gives a full description of the disease. It follows after a variable time, which may be months or years, the ulcers on the skin, which he regards as the chancre or initial lesion. He found no organisms but in excised areas from the palatal lesions which he sent Lavaran the latter found Leishmania both free and enclosed in cells. The organisms are round, of the same size as the Leishmania, have a nucleus and centrosome, but differ from the Leishmania of Oriental Button in that the nucleus is flattened and closely applied to the wall. The organism was present in very small numbers and he regards it as a variety of the Leishmania tropica. In other parts of Peru the condition is known as Uta and material from these cases was studied by the expedition to Peru carried out by the Harvard Department of Tropical Medicine in 1913, and the organisms in small numbers were found both

in smears and sections: ("Report of the First Expedition to South America, 1913"). Similar conditions have been described in other parts of Brazil, in Peru, in Paraguay, and on the Isthmus. The Espundia is well known, not only in Peru, but in Bolivia, Ecuador, and Colombia. The best clinical description of the ulcers is that given by Matta of Manaos (*Bull. de la soc. de path. exot.*, vol. ix, 1916). "The ulcer begins with itching of the part, followed by elevated papules. Two to five days afterward small pustules, in size from the head of a pin to that of a grain of wheat form, which rupture and discharge a purulent yellowish gelatinous material. The small ulcers so formed extend by infection of the surrounding surface, by the secretion, and also by means of the lymphatics. The ulcer becomes covered by a crust, beneath which a quantity of intensely foetid pus is retained. On removing the crust there appears a deep ulcer with projecting edges. Cases rarely recover spontaneously, leaving large permanent cicatrices." On one patient Matta found fifty-one lesions which exhibited every phase of development up to cicatrization.

There is a general inclination to attribute the cause to insect bites, and all the common insects with the exception of the mosquito have been accused in turn. Where there is a prominent and disagreeable insect in a region and ulcers at the same time are common, the additional burden of the ulcers is loaded upon the shoulders of the insect. It has been given a great variety of local names and is generally recognized by the common people as a definite disease. It occurs most generally in the virgin forests of the upper sources of the rivers, though cases occur in the vicinity of Pará and Manaos. It is particularly common among the rubber gatherers who are most exposed to insect bites, have chronic malaria, are

badly nourished, and live miserably in the forest. One point always alleged in favor of insect transmission is the occurrence of the ulcers on uncovered parts of the body, but it should be remembered that these parts are

FIG. 28. LEISHMANIA ULCER OF THE ORIENTAL BUTTON TYPE. MANAOS.

most subject to traumas of all sorts. The skin in the tropics, owing to the constant maceration with sweat, is not so perfectly protected by the horny layer of epidermis, and owing to the scratching of insect bites, erosions which easily become superficial ulcers arise. There are mild forms which closely resemble the Oriental Button and which easily recover, and severe intractable forms.

The most intractable forms are those in which the mucous membranes are attacked and the disease may extend from the palate to the pharynx and larynx, leading to death. Similar ulcers have been found in dogs.

Vianna (*Arch. braz. de Med.*, Anno II), quoted from Carini, led by the good results of tartar emetic treatment in trypanosomiasis, was the first to try this remedy here. He obtained good results and it has become the accepted mode of treatment. This is administered intravenously in doses of 5 to 10 c.c. of a 1 per cent solution.

FIG. 29. CICATRIX ON SCALP FOLLOWING ULCER OF THE TYPE OF ORIENTAL BUTTON

Of the ulcers we saw in the hospitals there were a number which corresponded with the descriptions given of these specific ulcers. They could be classed under three heads. First, ulcers which were usually single, with firm elevated oedematous borders, sharp in outline, the entire ulcer elevated and covered with a firm adherent crust. The type of these is given in Figs. 28, 29, that of the second case being a healed ulcer of the scalp. These cases are very similar to the Oriental Button, which, however, does not occur on the scalp. In the second class the ulcers, single or multiple, are usually situated on the extremities, the edges are sharp and irregular, the base covered with soft projecting granulations. The ulcers extend laterally, but chiefly by the formation of foci in the adjoining tissue, which coalesce, giving rise to large ulcers with

great irregularity of outline (Fig. 30). The ulcers often heal spontaneously, leaving thin parchment-like cicatrices.

This character of cicatrix was very evident in that resulting from a large ulcer on the anterior tibia which

FIG. 30. A GROUP OF LEISHMANIA ULCERS. MANAOS.

had been contracted in an exploration on the Uaupes river (Fig. 31). The outline was irregular and the entire cicatrix was thin, parchment-like, of a pale blue grey color, with superficial tortuous veins. There was a marked tendency to breaking down of the cicatrix under slight traumas. The third type is that in which the mucous membrane of the nose or palate is involved and which may accompany or follow the skin forms. In certain cases a skin ulcer of the face may extend to

an adjoining mucous membrane, and in certain cases the mucous membrane seems to be affected primarily. These cases seemed to heal up rapidly under the antimony treatment.

Histologically the ulcers differ in a marked degree from typical cases of Oriental Button, in the absence

FIG. 31. CICATRIX ON LEG THE RESULT OF LEISHMANIA ULCER. THE CICATRIX IS THIN, PARCHMENT-LIKE, THE EDGE IRREGULAR, NO CONTRACTION EXTENDING FROM CICATRIX. THE UNDERLYING TISSUE HARD AND ANAEMIC.

of the great numbers of large phagocytic cells containing the Leishmania. The granulation tissue is not very vascular; there is marked thickening of the walls of the vessels by proliferation of endothelial cells and active migration of leucocytes. The general tissue is oedematous, the oedema extending well beneath the adjoining

epidermis, and foci of fibrin are found in it. The prevailing cells are of the plasma type and these are both collected in groups and generally infiltrated. The surface is covered with pus cells and a thin layer of fibrin. The epidermic edge of the ulcer proliferates extending over the surface and sending deep prolongations into the oedematous granulations, but the cells are separated by an intercellular oedema and become necrotic. The

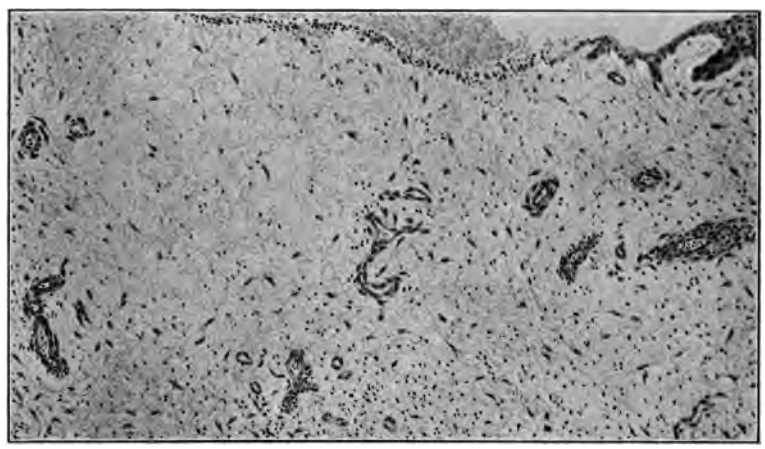

FIG. 32. LOW POWER DRAWING OF SECTION OF LEISHMANIA ULCER SHOWING OEDEMATOUS TISSUE AND ENDOTHELIAL PROLIFERATION.

same process takes place in the sweat glands. There is but little proliferation of the connective tissue and an entire absence of the dense, newly formed connective tissue which covers the base of our common *ulcus crunis* (Fig. 32).

All observers agree in the great rarity of Leishmania in the ulcers. They are chiefly on the surface and more readily found in smears than in sections. In the older ulcers, with marked suppuration, they are generally absent. We made a number of smears from the ulcers in Pará and in Manaos, and were not able to find

organisms in any of them. These smears were stained after we returned, and were overgrown with fungi and in bad condition. We also brought pieces removed from a number of ulcers in securing which not much choice was possible and several of them were evidently from ulcers of a different character, or of a chronic type. In two cases only, of recent ulcers in which the oedema and indolent character were marked, were organisms found, and that after a prolonged search. They were both free and intracellular and chiefly on and immediately beneath the surface. They each showed the characteristic trophonucleus and the punctiform kineto nucleus opposite. The accompanying illustration is made from a sketch by Professor E. E. Tyzzer (Fig. 33). We were not able to secure sections from the ulcer on the forehead which closely simulated the Oriental Button.

FIG. 33. LEISHMANIA FROM SURFACE OF ULCER.

Certain of the large deep ulcers which we saw simulate the simple tropical ulcers and the sections corresponded with the histology of those which were studied by Dr. Wolbach and which are probably due to spirochaetae.

On the whole it seems to us evident that there are in this region ulcers due to a variety of causes. Some of them correspond to the type generally referred to as tropical ulcer, the most probable causative organism being spirochaetae. There are other ulcers, due to a combination of trauma and general malnutrition (Fig. 34). We saw two cases in which the ulcers were epidermoid carcinomas. Syphilis in all forms is common and some of the ulcers are probably due to this. It is very

probable that yaws prevails in the region, and some of the ulcers may have been due to this. Among the many names of the Leishmania ulcers is that of "forest yaws." We saw, however, no cases of yaws, at least none so diagnosed. We did not see the types of varicose ulcers which are so common here. There are other ulcers of a true specific character, due to Leishmania

FIG. 34. SECTION OF ULCER OF INDETERMINATE TYPE. COMPARE WITH FIG. 30.

and which have definite clinical and histological characteristics. The thorough differentiation of all these types of ulcers is not possible with the facilities which the hospitals offer. It is by no means certain that a careful study of the ulcers in our country, particularly in the south, will not show the Leishmania form here.

CONCLUSIONS

No one can come into even superficial contact with this vast region without having his imagination stirred

by the thought of what the future may bring forth.[1] Up to the present it is a virgin land on which man's efforts have made no impression, and he has not turned the natural forces to his advantage. He has to a limited extent lived in the region by utilizing some of the products which nature so abundantly provides. Some of these are used directly and for sustenance, others are used indirectly and as objects of barter. The most prominent example of the latter is rubber and there can be little doubt that its exploitation has been a terrible calamity to the native inhabitants of the country. How great this calamity has been, in the destruction and degradation of the Indian population, we have no accurate information, but all we are able to learn shows that it must have been very great. Of the other strictly forest products nuts come next in value, but owing to their bulk and small value, these can never be exploited to the same degree.

[1] Humboldt saw a glorious vision of the future with the utilization by commerce of the incomparable system of waterways. There is water communication everywhere, throughout the valley, extending into Bolivia, Peru, Ecuador, and Colombia, which could be easily made available for light draught steamers. Venezuela and the Argentine could be reached, the former by the Cassiquiare Canal and the latter by the construction of an eighteen-mile canal between the head waters of the Tapajos and the Paraguay rivers. Great interest in the region was excited in our country by the glowing articles of M. P. Maury, the eminent oceanographer, in the *National Intelligencer*, which were afterwards published in pamphlet form, 1853. The exploring expeditions of Herndon and Gibbon, sent out by the United States Government, going into the valley from the west, the former descending the Huallaga and the latter passing from Peru into Bolivia and descending the Madeira, added to the interest. Both of these expeditions were well organized, well conducted and productive of much information regarding the physical features, and the products of the land. The immediate object was to obtain concessions from the governments for steamboat navigation, but it is not improbable that the ulterior but more important object was to discover whether the country was a suitable one for emigration with the extension of slavery.

There are present throughout the region three conditions which are most favorable for growth; heat, abundant moisture, and a fertile soil; and the growth is prodigal. At Pará there is a silk cotton tree in the grounds of the museum five feet in diameter above the buttress, which has grown to this size in nineteen years from the seed. At Umarituba there is a Brazil nut tree forty feet high which was planted as a sapling five years before. Rubber trees grow readily from seed and can be tapped in fifteen years and the two principal nut trees begin to bear in eight years. A still more remarkable example of rapidity of growth was seen in the forest at San Isabel. An immense tree in full vigor had fallen at some recent period for the dried leaves were still retained on the branches. The fall of such a tree leaves a definite hole in the forest roof which was occupied by its crown, yet at the time we were there the roof, by the extension of the adjoining trees, had closed up again. The bishop of Santarem told us that he obtained three crops of grapes yearly from the vines in his garden, and three crops of corn also can be obtained in the same year. When the forest is removed and the land pastured it produces an abundant, even luxurious, fine grass which is very nutritious; cattle are fat and the pastures seem to support a large number to the area, in one place we thought about one and a half cows to the acre. The great wealth of the land is in the forest which covers it and up to the present this has not been touched, no means having been found for its commercial exploitation. Bates in 1850 speaks of the great difficulty he found in procuring boards out of which to construct boxes for his specimens, and the boxes in which the rubber is packed up to three years ago were made of

the life of the country and most of whom did not make use of precautions which we would now regard as essential, lived in the country without much disability from sickness and without any permanent impairment of health. Humboldt had several attacks of fever during his stay but lived to an old age. Both Spix and Martius suffered from fevers and the early death of Spix may have been partly due to the illness which he underwent here. Bates also had attacks of malaria and probably dysentery, but attained old age. Spruce had the same experience and seems finally to have died of chronic ulceration of the rectum, probably the result of dysentery. The brother of Wallace died of yellow fever in Pará, and the naturalist, though several times attacked with fever while in the country, died but a few years ago. Chandless had fever and indeed this seems to have been an almost universal experience, although no mention of it is made in Mrs. Agassiz' account of the Agassiz expedition. Bismarck does not seem to have undergone any loss of vigor in consequence of the year spent here as a member of the expedition of Prince Adalbert. Rice, using modern precautions, on the Uaupes escaped malaria but acquired tropical ulcer. Smith was the most fortunate. During a residence of four years in the country, before prophylaxis was known, he escaped malaria but on his return to the United States acquired the disease after two weeks' residence in Ohio. There is an interesting circumstance regarding malaria which comes out prominently in all the accounts of the old explorers. In the ascent of rivers all would go well until the upper waters and the rapids were reached. Food was here less abundant, the work of pushing up the boats arduous, the men were continually wet from work in the water and constant rains, and fever would usually appear,

which is easily understood if we assume that the crew already had the disease in latent form. It is not improbable that some of the severe fevers encountered were yellow fever and not malaria.

Catarrhal conditions of the respiratory mucous membranes as evidenced in coughing, hawking and spitting, seem to be common, although severe infections of the parts are rare. On the steamers it is not uncommon to see a pool of expectoration beneath the hammock. How much this unpleasant feature is merely a habit or how much due to conditions induced by constantly smoking the irritating tobacco of the country is uncertain. That it is not seen among the foreigners is in favor of its being merely a habit. The health of our party was good throughout, the only exception being a not severe case of aestivo-autumnal infection acquired during the descent of the Rio Negro by one of the writers who was somewhat careless both in regard to prophylactic quinine and mosquito net.

The health of the crew of the yacht was good during the entire expedition. They were on the whole young men of good physique and, with the exception of the officers, represented many nationalities. The yacht with the crew remained at Manaos for the three months of the Rio Negro expedition. Shore leave was freely granted and games on shore were arranged for them. The food was more than ample and no change was made from that to which they were accustomed. There were a number of cases of venereal infection acquired at about every port, chiefly of course at Manaos. There were no cases of malaria or dysentery. There was one case of continued fever which lasted for four weeks, part of which time was spent on shore in the hospital. The nature of this was not ascertained, but it seemed from

its course to have been a mild case of typhoid, although at the time there was said to be no typhoid in the city.

There are many foreigners in the cities, and so far as we could see these lead lives anything but hygienic, and the amount of alcohol consumed is enormous. The drink habit seems to be extended in the region, involving practically all who can obtain alcohol. Of course nothing definite could be found out regarding the effect of the climate and the alcohol on the duration of life, but as far as cursory observation and information given by physicians and others enabled us to judge, the people stood the alcohol just about as well as they would have in another environment. It has seemed to us if we selected the one disease of the region to which the greatest degree of physical degeneration is due and which indirectly furnishes the underlying cause of many infections, it is alcoholism. Venereal diseases, particularly syphilis, are prevalent. It will be observed that they do not enter at all into the causes of death in Pará and to a slight extent only in Manaos. Our statement regarding this comes from observation and from information gathered from physicians. We have never seen prostitution more open and more repulsive than in Manaos, and advanced cases of syphilis are not infrequently seen. It would be very interesting to get the Wasserman test of the entire city of Manaos. On the whole, as far as concerns health and food, there is no difficulty about living in the country. The greatest danger comes from malaria and with the ordinary precautions this can be avoided as well here as in any region where the disease prevails.

Probably the greatest bar to settlement of the country is not its diseases but the insects. In a locality infested

with piums and micuims life is hardly endurable, but the former are confined to river banks in certain definite localities and the latter to the pastures and may be avoided. They are absent in all houses, cultivated lands and paths which are kept free from grass. The pest of ants is a minor detail and one easily guarded against. There is one condition which we have not seen mentioned as pertaining to tropical life, and that is a greater vulnerability of the surface of the body. Small abrasions and wounds of the surface easily occur, giving possibilities of infection. It seemed to us this was due to thinning of the epidermis by the maceration of sweat combined with frequent bathing. Scratching of insect bites is particularly to be avoided. While scratching an itching surface gives a pleasurable sensation, the denial of this pleasure will lead to physical and probably moral betterment.

Apart from all these things is the country fit to live in ? In regard to the effect of tropical temperature on the life of the white man the data at hand are not sufficient for us to know much. The prevailing temperature of the region is undoubtedly high and remarkably even, probably about eighty or slightly above is the average temperature of the valley. There may be extremes of ninety-five and sixty-four; we saw 71° Fahr. at San Gabriel once at the end of a violent rainstorm and 68° Fahr. on the lower river after a storm. It seems to have been shown that the greatest mental and bodily activity of man coincides not with an even, but an irregular temperature. The experience at Panama has shown that the white man can undergo hard physical labor in a high temperature and preserve his physical well-being, but the test has not been long enough to show what would be the effect of continuous residence.

The writers were not conscious of any loss of energy and of general well-being when in the country save that due to a malarial attack in one of us. The machinery of the body becomes adjusted to the continuous high temperature, blankets are comfortable at night, and a drop of temperature to 70° Fahr. entails real discomfort. The eyes also become accustomed to the intensity of light, which at first is disagreeable, and shaded glasses become unnecessary. We did not find such intensity of light in the region as in the West Indies, which is probably due to the amount of moisture in the atmosphere and the blanket of clouds. The most intense light was given when the sunlight at midday was reflected from great cumulus clouds near the zenith. The time necessary for photographic exposures was not greatly shortened. Nights are always cool, giving opportunities for reading and refreshing sleep. Certainly the work accomplished by the naturalists who lived in the country shows no lack of mental and physical vigor. This is, however, an unfair comparison, for these men represented a highly selected material who had work to do and an incitement to work which does not come from mere living. Whether the white man in the tropics will expend force beyond that which is necessary for mere living is uncertain, and the probability is that he will strive to lessen even such endeavor by compelling others to work for him. It must be said that up to the present white men have not succeeded in founding a desirable state of civilization in the country, but there are various reasons for this. In the first place the initial Portuguese stock, although in the past it has produced hardy and adventurous spirits, represents an admixture of many racial elements some of them undesirable, and that part of it inhabiting Brazil has undergone deterioration by a strong inter-

mixture of negro.[1] Where we have found native Portuguese both among the laboring and the higher class, they seemed a virile people. The foreigners coming into the country have not the idea of settling and using the land, but of temporarily exploiting it. A rather interesting experiment was made shortly after the Civil War when a number of Americans from the southern states were induced to settle in the country. The experiment was naturally a failure; the colonists were totally ignorant of the country and were from a class which had always been able to live from the work of others. Some of them returned, some died, and a few intermingled, as is shown by an occasional name remaining. The captain of an English steamer expressed his surprise to me at finding some Portuguese on the river named Jennings. Even the English in the tropics have not been a working people, but have lived from the work of others, though they have often directed the work of the natives in directions to their advantage. Under this white control in the English colonies the natives have had just treatment and have attained a greater degree of well-being than without it.

In this country there can be no possibility of the development of such a civilization as in India for instance. There is no population to furnish labor. The Indians are few and seem to be rapidly diminishing. It is doubtful

[1] The history of the relation between the Portuguese and the Indian population does not form pleasant reading. From the first their efforts have been directed to the enslavement of the Indians and the forced utilization of their labor. This was interfered with by the missionaries and led to the expulsion of the religious orders, which was most unfortunate. The Spanish civilization entering from the west was not so sordid for it was primarily directed toward the Christianizing of the natives, and in the process their well-being was not neglected. The missionary work of the Jesuit and Franciscan orders in South America forms a bright page in the history of the church.

if even under just treatment they would be efficient in labor, although the experiment has not been tried. Where a minimum of work produces sustenance it is difficult to procure labor even for the rewards which civilization offers the savage, such as the rum, sewing machines, music boxes, and patent medicines already referred to. The importation of Asiatics has been thought of by the government as a possible source of labor, but it is doubtful if they could be induced to come for terms of years and the people fear the unrestricted competition of a vigorous race. Whatever the future development of the country, it seems to us that it must be by a people who themselves will work and who will slowly evolve a civilization adapted to the environment and which may be a high type.

But what is most needed in the country at present is accurate information about everything. For one thing the establishment of plantations for the experimental study of the agricultural possibilities similar to the experimental farms which in all civilized lands have proved to be of great service. Forestry stations where the forest could be intensively studied and the possibilities of its utilization determined would be of equal value. There are already at hand admirable opportunities for the study of the diseases of the country in such cities as Pará, where there is a well equipped, well conducted hospital, but owing to lack of properly trained men its superb opportunities for study are not availed of. It would be of great advantage to have some of our trained medical students serve an internship in this hospital and receive the stimulation which the study of new conditions brings. Throughout the most interesting parts of the region suitable opportunities for study do not exist and it would be important to establish a small

hospital and clinic at San Isabel on the Rio Negro, for the intensive study of the diseases of this region. Little can be effected by mere expeditions into the country, with superficial study of conditions, although by concentration on single problems something might be gained. The physical features of a country can be studied in that way and accurate information of great value obtained as is shown by Chandless' study of the Purus River and Rice's study of the Uaupes. The Agassiz expedition also should have given much knowledge of the fishes of the region but the material obtained was never described. There seems in the hurry of modern life and the intense differentiation of pursuits no room for the man who was formerly known as the naturalist, the last of whom seems to have been Fabre. We owe most knowledge of the country to such men in the past, who, living here for a long time, have studied life in its environmental relations and have given the world in fascinating description the knowledge they acquired. We allude particularly to Spix and Martius, Bates, Spruce, Wallace, Smith, and Belt, although the latter worked in another field but one in which much the same conditions prevailed. All of these men had the general knowledge which enabled them to study biological phenomena in their mutual relations and this in no way interfered with their intensive study of particular problems. It is just this long continued study which is necessary for acquiring the knowledge of the phenomena of disease in the country, and which will lead to the solution of some of its problems. It is a fascinating field for human endeavor and should attract to it men who are desirous of a service which has the double advantage of benefiting mankind and giving the worker joy in his work. Life in the country

is easy, it is inexpensive, the people so far as we have seen them are kindly, and hospitality is shown in all directions. It would hardly be too much to say that a decent man provided with a hammock to sleep in and a few changes of clothing could live and work in the country at a minimum of expense. Medical men would have a great advantage over other investigators in that their medical knowledge could be availed of, *but they must know how to pull teeth.* There is one thing to be borne in mind; the Amazonas is a country of one language; that language is Portuguese, and its attainment is not easy. The only interpreters available are the Barbados negroes, their capacity is limited, and facility in the language is a *sine qua non.*

The land is a fascinating one. The sky, the forest, the rivers, have a beauty all of their own and unmatched. The great billows of white and purple cumulus clouds rolling to the west, mounting to the zenith, changing, disappearing, and forming, sunsets when sky, air, and water all glow with rosy light, the still nights with brilliant stars in the black sky, the dawnless day when the sun bounds into the sky, the marvellous beauty of tree life, particularly the palms, the great forest, beautiful, mysterious, fear inspiring, unchanged and unchanging, the exuberance of life, all these when once felt will never be forgotten.

Barbados

We arrived in Barbados November 23, and spent two days on the island. It is a small (166.3 square miles) very fertile island of coral formation, the principal city and harbor at Bridgetown on the west side. At the time

Fig. 35. Bridgetown: Avenue of royal palms.

we were there the island was very green and beautiful with great fields of sugar cane which was not yet being harvested. There are excellent hotels on the ocean and the climate though warm is not uncomfortable. Bridgetown is one of the most attractive tropical cities we have seen, the streets are clean, well shaded and most of the better class of houses have pleasant gardens with fine

flowers, the most prominent of these being the scarlet hibiscus, and blooming vines covered walls and arbors. The main shade trees are banyans, mahogany trees and mangoes, and there is one avenue lined with superb royal palms (Fig. 35). There is a small and on the outside attractive looking hospital which we did not have time to visit. The main industry of the island is sugar, and at the present time this is very profitable.

The most striking feature of the island is the number of negroes. They literally swarm in the town, the water side is lined with them, they appear in great numbers around the yacht in rude boats made of planks nailed together and find both profit and pleasure in diving for coins, showing great skill in this. As seen they are a ragged, rather jolly-looking lot and their nutrition is good. Fish are abundant and good, and with fruit of many sorts, and yams and sweet potatoes and beans, form the staple food. Notwithstanding the number of negroes on the island there is a large emigration, and in Brazil we met them everywhere, and they often gave good service as interpreters.

The highest population seems to have been reached in 1891 when it was 182,306. In 1911 the population was 171,983, formed by whites 12,063, mixed 41,533, and 118,387 colored. The birth rate is high, 40 per 1000, the death rate low, and the population is kept within reasonable bounds (in 1911 it was 1034 per square mile) by emigration. Between 1861 and 1871, 31,787 left the island and this rate of about 3000 per year has kept up; 20,507 went to the Panama Canal alone. Of course emigration takes away the best part of a population and it is remarkable that the present population should give no evidence of decline in vigor. The very excellent police force on the island is negro with white officers.

The relation with the whites is good, there are sufficient schools and as we have seen these Barbados negroes in Brazil and in the United States, they appear far more industrious and intelligent than do the negroes of the southern states.

The island must be regarded as one of the most healthy of places in the tropics, so far as we have means of judging. Law (" Malarial and Filarial Diseases in Barbados," *Jour. of Tropical Medicine*, 1901) found no malaria and no anopheles mosquitoes. Careful examination of the water of the two swamps on the island showed no anopheles larvae which substantiates the claims of Barbados medical authorities that all cases of malaria are imported. Filariasis on the contrary is common; 12.66 per cent of 600 people examined showed the parasites and the *culex fatigans*, one of the carriers of the disease, is numerous. A rather large percentage of the positive cases of filaria, 35 per cent, showed pathological conditions, elephantiasis, chyluria, lymphangeitis, depending upon this. Daniels also states that among the large numbers of Barbados negroes who annually emigrate to British Guiana he found no large spleens or evidences of chronic malaria.

Porto Rico

On our return we reached Porto Rico on April 15 and spent three days on the island. The harbor of San Juan is spacious and almost landlocked, being inside of a long projecting point on the north side of the island. The town has nothing of the aspects of a tropical town, and is lacking in picturesqueness. The houses generally of two or three stories, are in contact, there are no gardens about them, no vines clambering over walls. The streets generally clean, are narrow, as are the sidewalks.

There are few trees in the city, the public squares are few and not in good condition, and there is no park worthy of the name. The town gives the impression of prosperity. The idle negroes on the water front, usually a familiar sight in the tropical American cities, are lacking, and there are few only who pick up a precarious livelihood as watermen. There are few cafés and drinking houses and few idlers.

The suburbs, which have undergone a considerable extension since the American occupation, cover a much greater area than the city itself, extending for miles into the country. Most of the houses are new, a few of them attractive looking, and have small gardens around them. It is singular that in building advantage should not have been taken of what the experience of ages has shown to be the most suitable for the tropics. A low house with walls of some heat-resisting material, an inner shaded court, large rooms with comparatively small windows so that both light and heat can be excluded, and floors of tile, brick, or clay. The color is also important and should not strongly reflect the sun's rays and should harmonize well with an environment in which the verdure of growing things predominates; a soft pink seems best to meet this requirement. The majority of these new suburban houses are just such as we might see in an American suburb. There are several conveniently placed and well operated tramway lines, and excellent and relatively cheap automobile lines running between all of the principal cities.

Ponce, on the south side of the island, connected with San Juan by a wonderful automobile road, is much more attractive. There are a number of handsome squares with well cared for trees and shrubs and the streets are shaded with fine mango trees. The houses are separated

and there are gardens about them. It would seem to have been more of a residence city than San Juan and to have had well-to-do residents.

The island is mountainous. There is an irregular chain of mountains in the centre with summits up to forty-six hundred feet high with lower mountains which extend chiefly on the north side. On the south side the slope to the sea is more regular. The interior is much broken up, there are numerous valleys, never broad but narrow, some of them rather ravines than valleys. Nor are there any broad plateaus on the summits, but the whole landscape is broken up with ridges and sharp peaks. The soil appears to be very light but good, and is cultivated on mountain-sides so steep that horse labor would be impossible.

The rainfall is abundant, but with marked local variations and greater on the north than on the south side of the island. The soil, notwithstanding its lightness, seems to possess some peculiar quality which prevents it from washing. Numerous streams come down from the mountains and the water is extensively used for irrigation on the sugar plantations on the south side of the island, this being assisted by the construction of reservoirs in which the water is impounded. There is intensive cultivation of the land in the western two-thirds of the island, the main crops being tobacco, sugar, and coffee. Most of the tobacco is grown in the narrow valleys in the interior of the island, and on the steep mountain sides. In places there are large areas of tobacco grown under cheese cloth. There are great plantations of sugar, generally owned by companies, and the cultivation is on a large scale. Coffee, and there is no better coffee, is grown on the summits of the mountains in the interior. The coffee plantations received great injury

from a hurricane in 1898 and have never recovered from the damage, as both the coffee shrubs and the trees which protect them were destroyed. A railroad, with infrequent passenger service, extends around the island, with branches running inland and from this there are spurs and often temporary tracks extending into the sugar estates. A great deal of the cane is hauled to the mills on these roads, but the bulk of it is hauled on carts drawn by single or several yokes of splendid oxen. The mills are large and placed at intervals. The population is large and concentrated at more highly cultivated regions. There are comparatively few negroes and the admixture with negro blood is not so manifest as in Brazil. There is a great concentration of people in villages and small towns, particularly on the southern side of the island, where the sugar estates are situated. The people of wealth seem to live in the cities, at least no large residences were seen in the country. The people, as they are seen along the roads, and elsewhere, particularly among the mountains, do not give the impression of good health and nutrition. They are rather pale, spare, and seem devoid of vigor. There is a singular difference as compared with the peasant class in Brazil. Shoes are very generally worn, although we did see an occasional barefoot laborer.

We had the opportunity of seeing the pupils in a large public school of the middle grade in San Juan, and here the children in point of health and nutrition seemed to be in a fair state. A primary school was also seen in one of the interior towns, and here also the much younger children looked pretty well. Shoes and stockings were generally worn by the school children. The general use of foot covering was probably a result of the vigorous

hookworm campaign which began with the remarkable work of Ashford and King in 1902.

The general conditions of life of the peon, or laboring population, on whom the prosperity of the island immediately depends, seem to us deplorable. It is probably due to the fact that they own nothing of the island. Their dwellings are the most wretched shacks, worse than any human habitations we have seen. When situated in the fields the land is cultivated right up to the houses, giving no possibility for the domestic garden. These shacks are usually along the roads, and in the vicinity of the towns on the southern side there are collections of box-like houses so tiny that it did not seem possible that human beings could live in them, closely clustered, with no cultivated land belonging to them. Fruit is one of the necessities of the tropics and it forms in its many varieties of bananas, mangoes, oranges, breadfruit, etc., probably the most valuable and cheapest form of food. In the rapidity with which growth takes place it is possible on an area of one hundred and fifty feet square for an average family of five to raise all or nearly all the fruit and vegetables, the most important of the latter being yams and beans, that it requires. In no place we have ever seen, save in the heart of a great city, is there such a complete deprivation of the toiler from the use of the earth as here. The wretched peon must buy everything and the very insufficient wage gives him only the poorest food in insufficient quantity. Meat he never tastes and the diet is practically confined to salt fish and rice. With the garden it would be possible, even without some use of the surrounding crops belonging to the soulless corporation, though this might be considered legitimate, for the laborer to raise a few

pigs and chickens which would give him the requisite animal food. It is interesting in this respect to recall conversations which we had in Brazil with other than the laboring class, in which the misfortune of the country in the lack of an active and efficient laboring class was attributed to the easy culture of the bananas and the abundance of fish in the rivers. For, said they, no man will work if he can without trouble build a house anywhere in a few hours, pluck bananas at his doorway and in a half-hour of the pleasant diversion of fishing secure the meat for a couple of days. While there is no doubt that a greater necessity for struggle of maintenance will produce qualities excellent for a race, there is equally no doubt that such withdrawal of the use of the land from the people leads practically to a condition of slavery where people must work, and in prescribed ways, in order to live. We have spoken of this matter, having in view not so much the social aspects as the medical aspects. Medicine aims primarily at the freeing of a people from the chains that disease lays upon them, disease not only giving pain and suffering, but preventing the legitimate enjoyment of the fruits of life. The strictly medical work which has been accomplished in Porto Rico by the campaign against the menace of the hookworm, the provision of laboratories and hospitals, has been most excellent and beneficent, but restoration of the use of the earth to the people in some measure would be of greater value. No permanent reform, either social or medical, will be possible without it.

There is an interesting relation between the agricultural conditions on the island and diseases. Following the American occupation there was a careful survey of health conditions and as a result of the extensive and

serious conditions which were shown to be produced by hookworm infestation an energetic campaign against this was instituted in 1902 and splendidly directed by Ashford and King. Dispensaries were established for treatment in the cities and in the towns throughout the most populous part of the island, and the treatment was effective, as shown by a re-survey and determination of hemoglobin. It seems to us, however, doubtful whether there can be a thorough extirpation of the hookworm in a region where infestation is so general. The most effective measures are educational and social, rather than medicinal. That the people are aware of the nature and importance of some of these preventive measures is shown by the general adoption of foot covering. The most important preventive measure, the provision of privies and the prevention of soil pollution with the faeces containing eggs, has made no headway. It is doubtful if there is a single privy in the rural districts of the island, certainly none were seen. The hookworm campaign, however, hardly affected the mountain districts, where coffee is the main crop and where the population is sparse. Coffee culture has not been profitable, the plantations were destroyed in 1898 and the coffee, although of excellent quality, is not generally highly esteemed by us and formerly was consumed in Europe exclusively. The coffee of Vienna, which all who have been there will remember with pleasure, was produced in Porto Rico. In this coffee region the road system which is so admirable elsewhere, hardly penetrates, the villages are inaccessible and the bodily strength and intelligence of the people below the average which obtains elsewhere. The best of the population go into the sugar and tobacco regions where the conditions of life are more favorable and the remaining

population ekes out a miserable existence. Payment for work on the plantations depends upon the amount of labor given and is by piece, and a vicious circle results in that the greater the weakness produced by the disease the less work can be accomplished, the wage is reduced and poverty and ignorance are the most important accelerators of the hookworm morbidity. In the coffee region there is universal soil pollution, combined with dampness and shade, which prevents the drying-up of the faeces; and the beneficent though in some respects disagreeable scavenger, the ant, does not play the important rôle which it does in Brazil. Poverty prevents in this region the general use of foot covering which is a very important means of prevention. Physicians are few in the rural districts and the poverty of the people would not enable them to receive the proper recompense for medical work. Under such conditions practically the entire medical care is taken over by the drug stores in the villages, to which the people resort, and under these conditions the patent medicine evil flourishes. It is a pity that the dispensaries which were instituted during the hookworm campaign were given up from lack of means. Instead of that they should have been extended and combined with a system of small hospitals. More important than roads or even schools is the health of the people. Schools, of course, play an important rôle and there cannot be much advance unless the means of communication with the past as well as the present be possessed, but the part which the school plays in increasing the power, the well-being and happiness of a people is grossly overestimated. Money had much better be used in promoting the health of a people than in an extension of what may in great part be regarded as useless work. A hospital, in addition to the imme-

diate good which it accomplishes in the relief or cure of disease, is an educational factor of great value. And the knowledge of proper living and of the means for care and prevention of disease which the people acquire while living in the hospital is a part of education, and as an agent for the extension of morality the hospital is of as great value as a church.

Malaria, of course, exists, but it does not seem to play as great a rôle in the country as it does in parts of the Amazons. In San Juan we visited the small but excellently administered public hospital. It presented the evidence of what excellent work can be accomplished with means seemingly inadequate but used with intelligence and directed by scientific enthusiasm. The hospital is an old building, small and inadequate. It did not, for instance, compare in material aspects with the hospital in Pará, but one had only to enter the wards to see that a totally different spirit prevailed. The manifest difference was accuracy of diagnosis, knowledge of the condition of the patients, based on scientific study, and with this a far greater interest in the patients. This seemed to be due to the presence in the hospital of a trained pathologist with a laboratory pretty well equipped for simple work, and who possessed energy and scientific interest. One thing we were told there which was interesting, was the relation between childbirth and malaria. In patients with chronic malaria, but who showed no symptoms whatever of the disease, childbirth was frequently followed by an acute exacerbation of the disease. This was probably to be attributed to the increased intra-abdominal tension of labor, forcing into the circulation organisms which were quiescent in the spleen. By work in the hospital the great frequency of filaria in the island was determined.

This, however, seems to produce no symptoms. We were informed by the very capable administrator of the hospital that, owing to the increased cost of living, his salary had been reduced.

We also had the pleasure of visiting the government laboratory, which is under the direction of Major Ashford. It is a well provided and administered institution and was organized shortly after the American possession. The laboratory was the efficient instrument in the suppression of yellow fever on the island, the centre from which the hookworm work extended, and from it have come some notable contributions to knowledge of disease. The most recent of these has been the work showing the etiology of sprue, which is one of the serious tropical diseases. What a change is represented in the general point of view when almost the first thing which a government does when it becomes possessed of a new land is to establish a laboratory for the investigation of disease! On the medical care of the people and the prevention of disease the happiness and well-being of the people, and the success of the administration primarily depend.

The schools on the island, each proudly displaying an American flag, are numerous, and those we visited were well attended and administered. Of those in the country districts we could not judge. We were informed, however, by the principal of one of the high schools that the accommodations were inadequate and that two hundred and fifty thousand children on the island were without schools, but this is probably an exaggeration.

It is impossible to leave this very interesting island without offering, but in a spirit of modesty, certain suggestions. All suggestions of course should be made with a full knowledge of environmental conditions, and these

cannot be ascertained in a visit of three days only. Certain things seem to be apparent, but whether the suggestions could be put in force and whether if so they would be beneficial must be left to the judgment of others. The first would be in regard to the relations of the laboring class to the land. The people should live on the land where they find employment and each house should be provided with land on which the settler could raise an important part of his food. Provision should be made by the government for the people to acquire possession of a home on easy terms. The collections of dog houses about some of the towns, in which the people live, should be destroyed. It is such conditions in which the people have no stake in the land, nothing to lose, and possibly something to gain, by a change, which make revolutions possible and true progress impossible. We believe that this is in all respects the most important social and medical reform which can be instituted. The second suggestion is the reëstablishment and the continuance of the medical foci for the relief of hookworm disease and other conditions. The wealth of the island primarily depends upon the efficiency of the labor used in the cultivation of the soil, and a laborer in whom hemoglobin is deficient can never be efficient.

Such a small island as this presents an interesting problem in government. There is sufficient diversity of interest to present problems of public economy, and conditions, both of population and region vary sufficiently to produce many problems of public health. The environment is small and the interrelations are not so complex as to render the problems insoluble. Moreover, mistakes both in political and health management are not so productive of harm as in more complex relations, the results are more quickly manifest and changes

can be more quickly made. In a certain way an island can be regarded as an experimental station, where various experiments in administration can easily be made and would entail little cost. For instance, on such an island the very interesting question as to the possibility of hookworm extirpation and even the best methods of permanent relief could be determined. Experiments in government might also be used to determine what is the end to be striven for, the general well-being and happiness of the people as a class or the unrestricted exploitation of both the soil and the people towards the end of wealth production. Living problems of education could also be tried out experimentally. It seems to have been shown that a nation by means of education carefully directed to one end and embracing such means of education as the school, the university, the press, the pulpit, and the army, can be radically changed, at least for a time. It might be determined whether nobler ideals than even well-being and happiness can be attained or whether all effort is vain.

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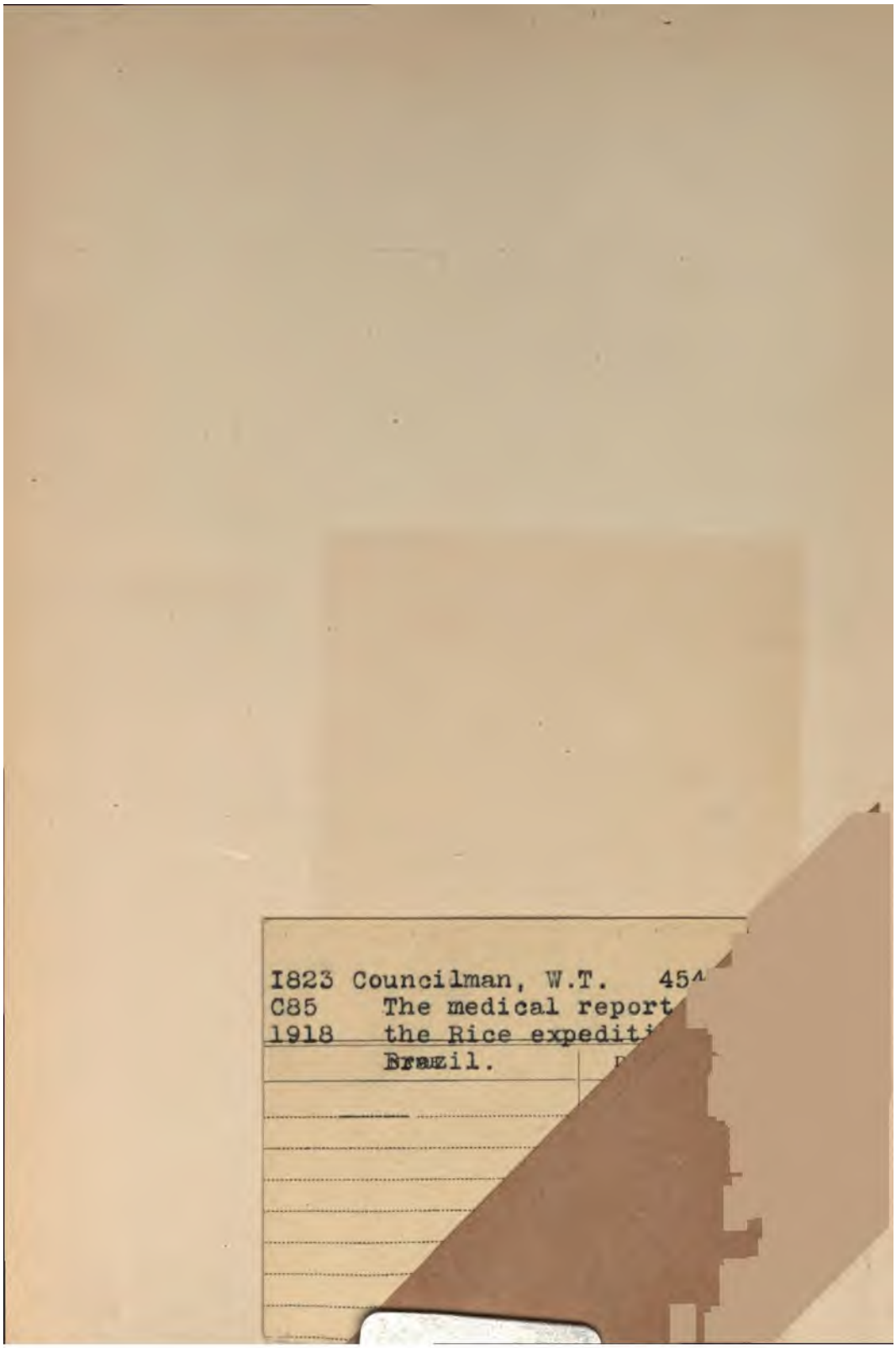
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